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Effect of Location, Procedural Explicitness, and Presentation Format on User Processing of and Compliance with Product Warnings and Instructions

by

James Paul Frantz

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Industrial and Operations Engineering)
in The University of Michigan
1992

Doctoral Committee:

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ABSTRACT

EFFECT OF LOCATION, PROCEDURAL EXPLICITNESS, AND PRESENTATION FORMAT ON USER PROCESSING OF AND COMPLIANCE WITH PRODUCT WARNINGS AND INSTRUCTIONS

by
James Paul Frantz

Chair: James M. Miller

Two experiments examined the effect of three presentation factors on the attention to and compliance with on-product warnings and instructions: 1) the location of safety information relative to usage instructions, 2) the procedural explicitness of precautions, and 3) the presentation format of usage instructions (prose vs. numbered list). The experiments also examined user processing of product information during task performance and assessed the benefits of a user-oriented approach to warnings design relative to current practice.

The first experiment examined the effect of presentation format and location of safety instructions. Eighty subjects used a drain opener with one of four labels. Contrary to current/recommended practice, substantially more subjects read and complied with warnings and instructions that appeared in the directions for use rather than the "precautions" section. On average, moving an instruction from the precautions into the directions increased the reading rate from 37% to 89% and increased the compliance rate from 48% to 83%. The presentation format of the usage instructions did not reliably affect overall label effectiveness, nor did it affect the way subjects used the information.

The second experiment examined the effect of precaution location and procedural explicitness of precautions. The same 80 subjects used a water repellent sealer with one of four labels. Including precautions in the directions significantly increased label

effectiveness, as did increasing precaution explicitness. Compared to the exemplar current label, procedurally explicit precautions included in the directions dramatically increased reading rates from 4% to 78% and compliance rates from 10% to 65%.

In both experiments, a design approach based on the assumption that users would be seeking task-related rather than safety-related information produced substantially more effective labels. Key to label improvement was a technique developed for analyzing existing/prototype labels. The experiments also produced a number of findings regarding user processing of product information, including insights into how and why users selectively process information on labels. This research is not supportive of labeling standards, guidelines, and regulations calling for precautions to be separated from product usage information (e.g., Environmental Protection Agency pesticide labeling regulations and paint/coatings industry labeling guidelines).

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CHAPTER I

INTRODUCTION AND GENERAL BACKGROUND

Initial Recognition of Research Area

The recognition of product information as an important area of human factors engineering has traditionally been traced to Alphonse Chapanis' presidential address to the Human Factors Society in 1964. In his address he stated:

> The main purpose of my talk today is to call your attention to a very large and important area of human factors engineering that is almost entirely neglected. This area consists of the language and words that are attached to the tools, machines, systems, and operations with which we are concerned. I shall try to convince you, by example, illustration, and data that changes in the words that are used in man-machine systems may produce greater improvements in performance than human engineering changes in the machine itself. I shall argue that this province...is properly the concern of the human factors engineer, and not of the grammarian, linguist, or the communication theorist (see Chapanis, 1965, pg. 1).

Chapanis' address, which later appeared as a journal article, dealt with the problems associated with written warnings and instructions. Chapanis was interested in how people process and act upon instructions and warnings, or as he put it, "What kind of specific human action will a person take when he reads this instruction?" This question was an increasingly important one as technological advances were providing the untrained masses with increasingly complex products, machines, and systems.

Interestingly, Chapanis' literature review of "intelligible" written information produced only one article. The lone article appeared in the Journal of Occupational Psychology and was authored by Conrad (1960), a researcher at the Applied Psychology

Research Unit at Cambridge. Conrad performed an experiment to measure people's ability to perform a particular telephone operating task using one of four sets of written instructions. This experiment was motivated, to some extent, by a situation in which a person's inability to use a public telephone had grave consequences. In particular, Conrad tells of a boy who left school in the afternoon and, to the dismay of his mother, did not return home. The boy died of exposure at a play area near his home. An investigation of the events surrounding the death revealed that the mother and neighbors were concerned about the boy, but none of them knew how to use the telephone at the end of the street, and as a result, the search for the boy was tragically delayed. Conrad recognized that accidents and injuries associated with people's inability to safely and effectively use complex products and systems were likely to increase if users were not provided with comprehensible information. He further noted that, despite the importance of the topic, psychologists had largely neglected the study of "...what people can and cannot understand when faced with a set of instructions or items of information..."

A final point regarding Conrad's paper is that he was able to re-organize and simplify a set of telephone operating procedures and substantially increase the proportion of people who could successfully complete the task (from 20% to 73%). Although his modifications to the original instructions were not theoretically driven, his results did provide some of the first evidence that a systematic analysis of the instructional information accompanying a product or system could yield substantially improved task performance.

At a fundamental level, Chapanis and Conrad had drawn a distinction between reading to *learn* and reading to *do*. Prior to the 1960s, very little research had been done on the topic of acquiring procedures from written instructions (i.e., reading to do). In contrast, vast amounts of "reading" research had been done on such topics as legibility, readability, and the comprehensibility of written material. These research efforts concentrated on the processes associated with encoding, comprehending, and recalling written information, but not the processes involved in formulating and executing responses

to procedural text. The legibility of print, for instance, which refers to the ease and speed of reading, had already been extensively studied at the time of Chapanis' address to the Human Factors Society (see Tinker, 1963). Legibility research had addressed such issues as the effect of type size on reading speed and search time (Gilliland, 1923; Greene, 1933; Glanville, Kreezer, Dallenbach, 1946), the relative legibility of black print and white print (Holmes, 1931; Paterson and Tinker, 1931; Taylor, 1934), and the relative legibility of different type faces (Roethlein, 1912; Burtt and Basch, 1923; Paterson and Tinker, 1932; Webster and Tinker, 1935; Luckiesh and Moss, 1937; Luckiesh and Moss, 1939; English, 1944). Legibility research continues today with a greater emphasis on the legibility of displays (cf. Gould, Alfaro, Barnes, Finn, Grischkowsky, and Minuto, 1987). With respect to readability, which deals with the level of mental difficulty required to read and understand a passage, much effort had already gone into developing models for predicting the level of skill needed to read a passage (Dale and Chall, 1948; Flesch, 1948; Klare, 1963). Readability research has also continued, and by 1979 there were more than 100 readability formulae (Duffy, 1985). Finally, a substantial amount of psycholinguistic research had been conducted on the cognitive processing of individual words (e.g., Deese, 1965) and sentences (see Charrow, 1980 and Kieras and Dechert, 1985 for review). Psycholinguistic studies into the comprehension of units larger than sentences (i.e., discourse) did not begin until several years later (Charrow, 1980). As with readability and legibility, psycholinguistic studies of comprehensibility have also continued. Of particular interest is the development of computerized systems, based on empirically derived rules, that provide writers with feedback regarding the comprehensibility of technical prose (Kieras and Dechert, 1985; Kieras, 1989).

Reading Versus Using: Practical and Theoretical Distinctions

Response to Chapanis' call for research into the "intelligibility" of written information did not come until the 1970s when several studies measuring the effect of various characteristics of information on task performance were published. As opposed to measures of reading speed and memory for text, these studies measured performance time and errors for different conditions. Example studies and findings include:

- Sremec (1972) found that including schematic drawings in a set of installation instructions substantially improved performance over the original, words-only version.
- Wright and Fox (1972) found that organizing a currency conversion table to minimize mental calculations resulted in better performance on a simulated shopping task.
- Wright and Reid (1973) found that presentation format (prose, logic tree, list of short sentences, or decision table) affected the speed and accuracy of performance, with bureaucratic prose performing the worst of all.
- Kamman (1975) found that speed and accuracy of telephone dialing procedures improved when the procedures were presented in a flowchart (algorithmic) format rather than standard prose.
- Wright and Threlfall (1980) found that the format of an index (either consistent with or inconsistent with reader expectation) affected the likelihood that users would commit errors during use of the index.

Following these initial empirical efforts, Patricia Wright (1980) authored a significant paper on the "usability" of written information. The thesis of the paper was that an analysis of the cognitive and behavioral demands placed on a document user is needed to facilitate designers' decisions about the language and presentation of written information. Such analyses would help develop written information compatible with the perceptual

strategies, conceptual knowledge, and information processing resources of the user. In advancing her position, Wright asserted that documents must be more than comprehensible; they must be "usable." That is, written information must not only allow a person to identify the meaning of the message being conveyed, but also facilitate the integration of the message with other relevant information and facilitate performance of an appropriate act. Drawing upon reading research, Wright argued that contextual factors such as task constraints (e.g., inability to re-read information), purpose for reading the information (e.g., skimming, memorizing, reviewing, and searching), characteristics of the text (e.g., subject matter, apparent length, and layout) and characteristics of the reader (e.g., reading ability, familiarity with subject matter) can significantly affect the usability of the text, perhaps more so than the words themselves. Furthermore, she asserted that these factors are likely to be a major determinant of the cognitive activities involved in processing instructional text.

Fundamentally, Wright drew a distinction between *reading* and *using* written information. She pointed out that reading was but one psychological resource employed during the use of written information and that psychological processes governing the reader's interaction with instructions may be quite different from those involved in understanding a short story. As a result, Wright concluded that people are more appropriately called users of written information rather than readers. The recognition that people use, as opposed to just read, written information to perform tasks suggests that designers of such information must be concerned with the layout and presentation of the information, in addition to the language used to convey the meaning. This perspective also suggests that people are likely to make a variety of decisions while using procedural text (e.g., instructions) that they typically would not make while reading non-procedural prose. Example decisions involved in "using" product accompanying information might include whether or not to read the information at all or how deeply to process various portions of the provided information. Along these lines, Wright noted that there was an urgent need

for research that would explore the presentation factors that influence the user's attention to various parts of a text. In response to Wright's observation, this dissertation research examines how three presentation factors affect the processing of and compliance with on-product warnings and instructions.

Distinction Between Research on Warnings and Instructions

From a research perspective, the topic of product warnings continues to be fairly distinct from product instructions. In considering a set of instructions, researchers and designers are primarily concerned with legibility, comprehensibility, and more recently, usability of the information. With respect to warnings, however, there are additional concerns. Namely, researchers and designers are concerned with the conspicuity or attractiveness of a warning, the extent to which it motivates or persuades the reader to comply, and the likelihood that a warning will be recalled at an appropriate time. Another distinction between research in warnings and instructions has been the measures used to evaluate effectiveness. Experiments evaluating instructions typically measure speed and accuracy of performance, whereas experiments evaluating warnings seldom measure overt behavior (i.e,. compliance with the warning). In fact, as of 1986, there were only about 10 published articles that reported behavioral compliance measures out of over 300 publications on the topic (Purswell, Krenek and Dorris, 1987), and the total had only reached approximately 25 by 1989 (see Dejoy, 1989). Instead of behavioral compliance, experimenters measure the reported likelihood to read warnings, reported likelihood to take precautions, readers' impressions of warning effectiveness, perceived risk associated with the product, and memory for warning messages (see Dejoy, 1989; Laughery, 1989; Miller, Lehto and Frantz, 1990). As a result, little is known about how product users interact with, process, and respond to product warnings during task performance. It should also be noted that even behavioral compliance measures provide limited insight into the

processing of particular warning messages. That is, casual observation of overt behavior (i.e., compliance with warning) typically does not reveal when and how long users attend to certain warnings and instructions. Thus, it is difficult to determine the relationship between the depth of processing of certain messages and the ensuing behavior.

A final distinction between research on instructions versus warnings arises from the disciplines from which theories, and guidelines have been developed. For warnings, the majority of research, theories and design guidelines have emanated from human factors engineers and applied psychologists. In addition, contributions have been made by academicians, researchers and professionals from a wide variety of fields including medicine/health care (e.g., Morris and Halperin, 1979), marketing/consumer research (e.g., Wright, 1979; Bettman, Payne and Staelin, 1986; Ursic, 1984), decision sciences (e.g., MacGregor, 1989), public policy (e.g., Morris, Mazis, and Barofsky, 1980; Hadden, 1986), communication sciences (e.g., McGuire, 1980; deTurck and Goldhaber, 1989; Goldhaber and deTurck, 1988), and economics (Viscusi, Magat, and Huber, 1986; Viscusi and Magat, 1987). In contrast, most research on instructions has been conducted by psychologists and psycholinguists and, only more recently, human factors engineers.

Academic Interest in Product Warnings

Response to Chapanis' call for research was slower for product warnings than for instructions. In fact, research on product warnings did not begin until the mid-1970s (Dorris and Purswell, 1977, 1978; Dorris and Tabrizi, 1978). One of the first studies of product warnings, now commonly cited as the "hammer study," was reported by Dorris and Purswell (1977) of the University of Oklahoma. They reported that, out of 100 high school students asked to perform a simple hammering task, none of the subjects noticed the warning label affixed to the hammer. Then, in 1984, a group of professionals at Failure Analysis Associates reviewed nearly 400 articles dealing with warnings and concluded that:

"No scientific evidence was found to support the contention that on-product warning labels measurably increase the safety of any product. There is evidence that on-product warnings have no measurable impact on user behavior and product safety" (McCarthy, Finnegan, Krumm-Scott, and McCarthy, 1984).

This paper prompted much debate within the human factors community and a number of researchers set out to investigate the claim that product warnings are not effective and to determine how more effective product information might be designed. Among them was a group of researchers at Rice University including Wogalter, Laughery, Brelsford, Laux, and Godfrey who embarked on a series of empirical studies examining the effect of users' perceptions of the product (e.g., perceived hazardousness) and warning characteristics (e.g., conspicuity, cost of compliance with warning) on various measures of warning effectiveness (see Laughery, 1989). Other researchers studied such issues as the effect of symbols on warning compliance (Friedmann, 1988), the effect of highlighting warning text on attention, recall and compliance with product warnings (Strawbridge, 1986), the effect of pictographs on attention, recall and compliance with product warnings (Otsubo, 1988), and the effect of an interactive warning label on attention to and compliance with the product warning (Gill, Barbara, and Precht, 1987). For the interested reader, a more thorough coverage of the warnings literature is provided by Miller, Lehto and Frantz (1990).

A Framework for Warnings Research

Several years of research into the warnings issue passed before a publication emerged that helped to structure the empirical research and reveal areas in need of future work. In 1986, Lehto and Miller authored "Warnings: Fundamentals, Design and Evaluation Methodologies," which dealt with written product warnings as well as other types of warning stimuli (e.g., auditory, tactile). Their book was the first to organize the

warnings-related empirical, theoretical, and practical literature into a usable form for assessing the state of the art. In addition, Lehto and Miller proposed one of the first models of the warning process which consisted of a sequence of information processing stages including: 1) exposure to a warning stimulus, 2) attention to the stimulus, 3) active processing of the stimulus, 4) comprehension and agreement with the message, 5) storage of the message, 6) retrieval of the message at an appropriate time, 7) selection of an appropriate response to the message, and 8) execution of the response.

Throughout the book, Lehto and Miller stressed the importance of designing and evaluating warnings in the context of task performance. Although this approach seems fundamental from a human factors perspective, much of the previous warnings research focused on features of the warning that would enhance its legibility and conspicuity (e.g., colors, signal words, prominent type, etc.), but little attention was given to how the nature of the task and the user/product interaction might affect the attention to and compliance with the warning message. Lehto and Miller pointed out that for a warning to be effective, it must have sufficient stimulus energy (i.e., be conspicuous) <u>and</u> be presented at critical times during the task. Essentially, they were suggesting that a warning judged to be highly conspicuous outside of task performance could still be filtered if presented at inappropriate times. The implication is that the nature of the interaction between the user, product, and warning must be considered during design and evaluation. In fact, with regard to facilitating meaningful processing of warnings, Lehto and Miller concluded that, "emphasis should be placed on evaluating the relative importance of integrating a [warning] message into the flow of task-related information as opposed to increasing energy levels or conspicuity. This is a research topic of pressing interest." Since the publication of their book, research into product warnings has continued with little attention given to determining: 1) how users process warning information during actual task performance, 2) what strategies might be used to integrate warnings into the flow of task-related information, or 3) the relative importance of integrating warnings into the flow of task

information versus increasing the stimulus energy. This dissertation research addresses these issues as they pertain to the presentation of warning messages within product accompanying information.

Current State of Product Information Design

Currently, product instructions and warnings are created by technical writers, product developers/engineers, and attorneys with little or no training in the areas of human factors/ergonomics, safety engineering, or cognitive psychology. More specifically, people who write product information, particularly warnings, typically have minimal knowledge of: 1) the processes involved in reading comprehension (as described by Just and Carpenter, 1987), 2) the results of empirical studies regarding the comprehensibility of technical prose (as summarized by Kieras and Dechert, 1985), or 3) the body of nearly 600 warnings and instructions related publications summarized by Miller, Lehto and Frantz (1990). Consequently, such empirical and theoretical knowledge on the subject is not incorporated into the design of product information. The result is often written product information that is difficult for people to read, comprehend, and act upon. Thus, even if the product information designer identifies the correct message to send to the user, the transmission of the message is often inhibited by the language used to convey the message.

In addition, fundamental human factors methodologies such as task analysis are seldom part of the product information design process. This situation often leads to incomplete information and warnings and instructions whose form, presentation, and location neither facilitate attention to nor use of the information. At a fundamental level, the current design of product information does not incorporate known research findings and empirically based rules and guidelines, and it does not explicitly consider product information in the context of individuals actually using products to perform tasks. Apparently, there has been little change over the past six years, recalling Robinson's

(1986) observation that, "The selection of appropriate warnings is a design problem that should receive the same kinds of concern and attention given to other hardware or software parts of the system. Too often, warnings are a simple 'add on,' with their form taken from other systems or general standards. Procedures of this sort deny both the complexities of a real design effort and the systems nature of warnings."

When designing and evaluating product information, especially warnings, manufacturers are often guided or directed by the requirements of consensual standards, industry guidelines, government regulations, and/or advice from attorneys regarding common law based criteria (cf. Moore, 1991). There are several problems associated with relying on these sources to design product information. First, since these sources are generally not scientifically based, the resulting product information lacks a scientific foundation which can lead to potentially ineffective product information. Such was the case with an extremely flammable adhesive that displayed a generic flame symbol mandated by the Canadian government. A field experiment by Frantz, Miller, and Lehto (1991) found that, although virtually everyone recognized the symbol and understood that it meant something about flammability, the symbol prompted only four percent of the subjects to recognize the product-specific precautions necessary to avoid serious injury (e.g., extinguish pilot lights). Another example involving product instructions comes from McCarthy et al. (1987) who found that the instructions for a child car seat, which were revised to meet Federal regulations, resulted in slightly more installation errors than the instructions appearing on the product prior to the regulations.

Second, when relying on standards, guidelines, regulations, and common law criteria, the designer may not perceive a need to evaluate the warning or instruction along such critical dimensions as conspicuity, comprehensibility, and overall behavioral effectiveness. Third, because of the perceived ability of these sources to develop "adequate" warnings and instructions, manufacturers often do not sense a need to seek assistance from professionals to design or evaluate their product information. Fourth, there

is virtually no need or incentive to develop product information in conjunction with the product itself. Instead, product information can be hastily assembled after the product design is complete and the product is ready for manufacture. Such a practice prohibits the product information design process from providing valuable feedback regarding the design of the product itself.

Finally, with standards, guidelines, regulations, and common law decisions as a foundation, product warnings and instructions can be designed and applied with no systematic analysis of potential users or the interaction between the user, product, and product information. The result is that information is presented in a form or located in such a way that it is unlikely to be integrated into the flow of task-related information. This failure to view warnings or instructions in the context of a particular product or in the context of actual product use seems to be a direct outgrowth of the increase in product liability claims alleging failure to warn or adequately instruct. Such claims have fostered a strategy of product liability prevention in the event of an accident, rather than designing information to prevent accidents in the first place. Because the primary goal is to refute claims of failure to warn, attorneys tend to view the warning in isolation (i.e., outside the context of product use or task accomplishment). As a result, characteristics of the product, user, and task are often overlooked in the design of warnings.

Dissertation Research Objectives

To summarize, product information design decisions are typically not scientifically based and the design process does not include a thorough analysis of the contextual and human factors that might affect the usability of instructions and warnings. This underdeveloped state of product information is due, at least in part, to: 1) designers' lack of knowledge regarding available research and general human factors principles, 2) designers' tendency to rely on seemingly well-founded guidelines, standards, and regulations, and 3)

designers' failure to develop product information via a design *process* that includes considering the interaction between the product, user, and product information during task performance. Finally, the advancement of the state of the art has been hampered by the human factors community's slow response to: 1) conducting basic research to determine how people use and process product information, 2) developing and validating practical methodologies for designing product information, and 3) convincing industry and government agencies that a systematic, human factors approach to product information design and standards is, in fact, necessary to yield fewer accidents and more satisfied users. At a very basic level, this dissertation research was directed toward remedying these academic shortcomings and ultimately, advancing the state of product information design.

To initiate such progress, the primary objective of the dissertation research was to examine the effect of three presentation factors on the attention to and compliance with on-product warnings and instructions. The presentation factors under investigation were:

1. The location of safety information (i.e., warnings) relative to usage instructions.
2. The procedural explicitness of precautions.
3. The presentation format of product instructions and warnings (prose format versus numbered list format).

These presentation factors are described in detail in the next chapter along with the research hypotheses associated with each.

In addition to examining the above presentation factors, the dissertation research had two other objectives which were intended to have more general applicability to both academia and industry. The first of these more general objectives was to systematically examine and document how people use and process product warnings and instructions during task performance. Gaining an understanding of how people use and process product information is necessary in order to provide sound guidance to designers of product information and developers of standards and regulations (cf. Venema, 1989;

Wright, 1980). The experiments described in Chapters 3 and 4 were used to achieve this objective.

The second general research objective was to assess the benefits of a user-oriented approach to product information design relative to current practice. This objective was achieved by contrasting exemplar current product labels with experimental labels based on the assumption that users' search for information would be driven by a desire to obtain task-related rather than safety-related information. A more detailed description of the approach is provided in Chapter 3. Key to this objective was the development of a technique for analyzing existing or prototype labels which is also described in Chapter 3.

Overview

By way of overview, the next chapter describes the background to the three presentation factors and the research hypothesis to be tested. Following that discussion, Chapter 3 describes the conduct and results of the first experiment in which the location and presentation format factors were studied. Next, Chapter 4 describes the second experiment in which the location and explicitness factors were studied. The dissertation concludes with a general discussion and design recommendations based on the findings from both experiments.

CHAPTER II

BACKGROUND TO PRESENTATION FACTORS

In general, when designing product safety information, one must determine 1) the hazards associated with using a product, 2) what information users need in order to avoid or mitigate the hazards, and 3) how to convey that information to users. For many consumer products, the medium of communication is written product warnings and instructions attached to or accompanying the product. In such cases there is another level of detail in the product information design process -- precisely how to present the information on the label, in the manual, on the hang tag, etc. This issue is of growing importance to companies seeking to develop effective, defensible product information.

Although considerable empirical and theoretical efforts have been expended on the cognitive processes involved in reading comprehension (Just and Carpenter, 1987; Kieras and Dechert, 1985) and acquiring procedures from text (Bovair and Kieras, 1991), much less consideration has been given to determining how physical features of instructions and warnings affect the processing of written information during task performance (cf. Venema, 1989; Wright, 1980). As a result, designers are faced with persistent questions regarding the presentation of product safety information. Common presentation questions facing product information designers and researchers include:

- Where should warnings be located relative to usage instructions?
- How explicit should the precautions be?
- Should the instructions and warnings be presented in narrative prose, numbered list, flowchart, decision tree format, etc.?

- How do warning symbols affect text processing? Do users process less text in the presence of familiar symbols?
- Where should statements of prohibited and permitted product uses be located relative to other product warnings and instructions?
- Do the aesthetic features of product information affect the use of the information? How important is it to make product information (especially instructions) visually appealing?
- Is the order of various warning components (e.g., signal word, statement of primary hazard, procedures for avoiding the hazard) an important design consideration? In particular, is the arrangement of warning components that is specified by current standards and guidelines actually the most desirable?

From the above list of presentation issues commonly facing designers, three were selected for study. Specifically, the presentation factors selected were:

1. The location of safety information (i.e., warnings) relative to usage instructions.
2. The procedural explicitness of precautions.
3. The presentation format of product instructions and warnings (prose format versus numbered list format).

The above presentation factors were selected on the basis of their anticipated value in assisting information designers to develop more effective labels and the extent to which investigating a presentation factor might contribute to the more general research objective of understanding how users process information during task performance. A description of each of the presentation factors along with the specific research hypotheses follows.

Location of Warnings Relative to Usage Instructions

It is a common practice for product warnings and precautions to be spatially separated from the instructions pertaining to product use (e.g., directions for use). This practice is consistent with a number of publications addressing product information accompanying various products. For example, the National Paint and Coatings Association's Paint Industry Labeling Guide (1985) calls for precautionary statements to be included in a general warning section that is separate from the usage instructions. Likewise, pesticide labeling regulations (40 CFR 156.10) and the Environmental Protection Agency's pesticide labeling guidelines (E.P.A., 1991) call for precautionary statements to appear in a section entitled "Precautionary Statements" which is separate from the "Directions for Use." In addition, practitioner-oriented publications also suggest that safety-critical information should be separated from nonsafety-critical usage instructions (Ryan, 1991; Schoff and Robinson, 1984). Ryan (1991) for instance, proposes a standard for product warnings which:

> ...divorc[es] the warning and cautionary instructions 'messages' from the text....The warning and cautionary instructions must be separated from the main text on the package....Many companies attempt to downplay the hazardous nature of their products by hiding the warning message in the product label rather than highlighting it. Examples of this practice include (1) integrating (embedding) the hazard warning label with the product instructions...Embedding the hazard warning message into the product use instructions is one of the most common forms of warning misuses (pp. 181, 183).

Thus, separating warnings from usage instructions is both current practice and the practice recommended by at least one author.

The current practice of separating safety information from other procedures is apparently based on the intuitive notion that safety-critical information buried or embedded in mundane procedural text has a greater likelihood of being overlooked, is less persuasive, and is generally less effective than warnings drawn out of the procedural text and presented separately. This approach is consistent with and perhaps fostered by the plethora of

product liability law suits founded on claims of failure-to-warn which suggest that if a statement isn't in its own "box" it must not be an adequate warning.

Despite the prevalence of the practice, the small amount of empirical research that has inadvertently touched on this issue calls into question the effectiveness of separating safety-critical information from usage instructions. Two experiments that were initially designed to study the effect of other warning features incidentally yielded results suggesting that separating warnings from instructions may not be a fruitful approach. In an experiment conducted by Friedmann (1988), subjects were asked to use either a liquid drain cleaner or a wood cleaner. Each product container displayed a label with a warning section explaining the need to wear personal protective equipment (e.g., gloves). The warning section was followed by a paragraph of promotional information and then the directions for using the product. During post-experiment interviews, Friedmann discovered that 20% of the subjects read only the first sentence of the warning section. When asked why they read only the first part of the warning, "the majority of the subjects stated that they were not interested in learning about the dangers of the product, but wanted to know what the product could be used for. Apparently the subjects' mind-set was simply to use the product, not to use the product safely." In another experiment, Strawbridge (1986) asked subjects to use a 12-ounce bottle of super bonding adhesive to bond two materials. The critical precaution associated with using the glue was to shake the bottle before using in order to avoid severe burns. As in Friedmann's experiment, Strawbridge found that many subjects reported skipping over the warning section: "Approximately 35% of the subjects reported that once they had read far enough into the Warning section to realize what it was, they stopped reading and continued on. This occurred despite the fact that the ultimate task was that of actually using the product; these subjects did not perceive that reading the warning was necessary."

In combination, these two experiments suggest that users tend to search for information pertinent to accomplishing their goals and, in doing so, they filter out other

information that is not deemed useful. Assuming that people generally want to use a product to accomplish a task as opposed to gaining declarative knowledge about the product and its hazards, the empirical results described above suggest that warnings or precautions that are part of a complete procedure for the safe and effective use of the product should be included in the usage instructions, as opposed to being separated from the usage instructions.

In addition to the limited empirical findings, another reason to integrate safety instructions into usage instructions is to provide users with a temporally ordered, complete procedure for the safe and effective use of the product in a central location. This is desirable for two primary reasons. First, providing procedures (precautions and otherwise) in a temporally ordered, central location reduces the cognitive demand on the user to collect, assemble, retain, and execute procedures for using the product in a safe manner. In theory, this type of presentation strategy would reduce user errors in executing procedures. Second, for products used repeatedly, it is important that users learn and remember a complete and safe procedure for using the product when they expend the time and energy to read the label, particularly since users are less likely to read information accompanying a product that they have successfully used in the past. As a result, it seems logical that a complete procedure should be available to users when they decide to read the instructions for use. This is especially important for those products where failure to take precautions does not always result in accidents or where failure to take precautions results in undetectable hazards that only become apparent at a later time or through repeated use of the product (e.g., improper maintenance or installation procedures).

In summary, there is theoretical impetus and limited empirical evidence to suggest that providing a complete procedure for using a product (including providing precautionary measures) in a central location will increase the likelihood that the product is used in a safe

manner. As a result, the first hypothesis to be tested was as follows:

> Safety instructions into the directions for using a product will increase the likelihood that they are noticed, read, and complied with, as opposed to providing the safety instructions in a separate section apart from the directions for use.

Procedural Explicitness of Precautions

A common challenge faced by warning designers is to clearly describe the nature and avoidance of hazards that can arise in a variety of ways. For example, products which emit flammable vapors present such a challenge. Explaining the nature of the flammability hazard is difficult, and explaining the specific precautions needed to prevent fires is also difficult given the myriad of ignition sources. The underlying question is how explicit should the warning be? One common approach is to provide abstract warnings and precautions that theoretically provide users with sufficient information to avoid virtually all hazards. For example, the precautions, "Keep away from open flame" and "Use in a well ventilated area" are phrases commonly used to warn people of the fire and health hazards associated with using a product. While such statements provide a message that is applicable to virtually all circumstances of product use, one can question the effectiveness of these statements in prompting users to understand and recognize the precautions that must be taken in a particular setting (cf. Lirtzman, 1984; Ryan, 1991).

In terms of comprehending a message and determining the appropriate actions to take, the non-explicit approach to providing precautions requires more inferences by the user to construct the correct procedure (see Bovair and Kieras, 1991 for a discussion of acquiring procedures from text). In other words, more procedurally explicit precautions would require the reader to make fewer inferences when constructing and executing a procedure than would less procedurally explicit precautions. Furthermore, procedurally

explicit precautions provide explicit referents to be acted upon whereas non-explicit precautions require the reader to identify context-specific instances of an abstract referent (e.g., a pilot light is an instance of the generic concept of open flame). Research by Frantz, Miller, and Lehto (1991) suggests that identifying context-specific referents can be difficult especially if there are several generic referents that are more easily brought to mind.

Of course, there are potential drawbacks associated with providing explicit precautions. First, generally speaking, increasing the explicitness of a precaution also increases its length. Second, making precautions more explicit introduces the potential for not warning about all possible hazard scenarios.

Despite the relevance of this design concern, virtually no published research has addressed the issue of procedural explicitness of precautions. However, based on the above reasoning, second research hypothesis was as follows:

> The explicitness of precautionary information can significantly affect the compliance with the precautions. In particular, the more procedurally explicit the precaution, the greater the compliance.

Narrative Prose Versus Numbered List Format

The third presentation factor examined was the presentation format of usage instructions (i.e., prose versus numbered list). Currently, presenting procedures in a numbered list format is common with instruction manuals. However, it is less common with on-product warnings and instructions, which is perhaps due to the space constraints associated with presenting information on a product. Specifically, a numbered list format may not be practical due to the need to maintain a legible type size in the limited space available on a product.

As with the location of warnings relative to other procedural text, recommendations exist regarding the presentation format of instructions. Berry (1982) and Bailey (1982) recommend that instructions should be presented in a numbered list format rather than in a narrative prose format in order to elicit better performance. In particular, Berry (1982) recommends that a step-by-step list should be used if the procedure is linear, has more than ten steps, must be contained in a limited space of a label on a machine, and is performed by one person. Although the numbered list format is widely used and recommended for instructions accompanying products and systems, the extent to which this format is useful in promoting the *safe* use of products as opposed to just increasing the ease of use of the product has yet to be determined.

Based on a general analysis of the cognitive and behavioral aspects of using a product and its accompanying information, the third research hypothesis was as follows:

> Presenting the procedures for safe and effective use of a product in a numbered list (step-by-step) rather than prose format will result in greater overall compliance with the product information.

Essentially, presenting a procedure in a numbered list format rather than prose format facilitates "reading-to-do" type tasks (Diehl and Mikulecky, 1981) in which information is read and directly applied. The numbered list format identifies individual steps to be executed and provides for efficient re-entry into the text after a step is executed. In contrast, narrative prose does not provide the visual anchors that a numerically ordered, step-by-step format does. For those product users who choose not to "read a little -- do a little" and decide to read all of a prose passage, there is the potential problem of decay in memory which can manifest itself in errors of omission. However, since very limited research has been conducted regarding how people actually read and process product instructions and warnings during the use of a product (cf. Venema, 1989), the above reasoning is without empirical foundation.

CHAPTER III

EXPERIMENT 1: EFFECT OF LOCATION AND PRESENTATION FORMAT ON ATTENTION TO AND COMPLIANCE WITH PRODUCT WARNINGS AND INSTRUCTIONS

Introduction

The primary objective of this experiment was to determine the effect of two presentation factors on the attention to and compliance with product warnings and instructions. The presentation factors under investigation were: 1) the location of safety instructions (precautions) relative to usage instructions, and 2) the presentation format of the instructions (prose vs. numbered list). Additional objectives of the experiment were to examine and document user processing of product information during task performance and to assess the benefits of a user-oriented approach to warning design.

Method

Selection and Description of Experimental Product

In the planning stages of this research, a number of desirable features of an experimental product were identified. First, it was desired that subjects have little to no experience using the product. This was important because the research was directed

toward those situations where users are likely to seek out product information to accomplish a task. Second, it was desired that use of the product involve numerous behavioral measures of compliance with the product instructions and warnings. Third, it was desired that the product present hazards which could be mitigated without the knowledge of the user. Finally, it was desired that the product or type of product have a substantial accident history such that the experimental results could be applied to an actual product safety concern.

A product that appeared to satisfy these criteria was a 100% lye (sodium hydroxide) crystal drain opener. Figure 3.1 shows the front of a fictitious drain opener product that was fashioned after a product currently on the market.

With respect to past problems associated with using drain openers, there is a substantial accident history associated with the use of 100% lye drain opener products as well as other drain openers such as those containing sulfuric acid (Herman, 1989; Sargeant, 1989; U.S. CPSC, 1979). For lye drain openers, typical accidents involve "blowbacks" or "splashbacks" of water and lye solution from the drain onto the user. Such splashbacks can result in blindness and severe burns to the face, arms, neck, and hands. The root cause of the splashbacks is the heat that is rapidly released when the lye crystals react with water and other substances in the drain. If the heat cannot be dissipated and/or the drain pipe is pressurized in some way (i.e., through plunging activities) the solution can explode. To reduce the likelihood of accidents and injuries, manufacturers indicate that it is important to use the proper amount of lye, dispense the lye in cold water, keep hands and face away from the lye solution at all times, never use a plunger after dispensing the lye in the drain, and wear personal protective equipment such as gloves and goggles to protect against splattering and splashback.

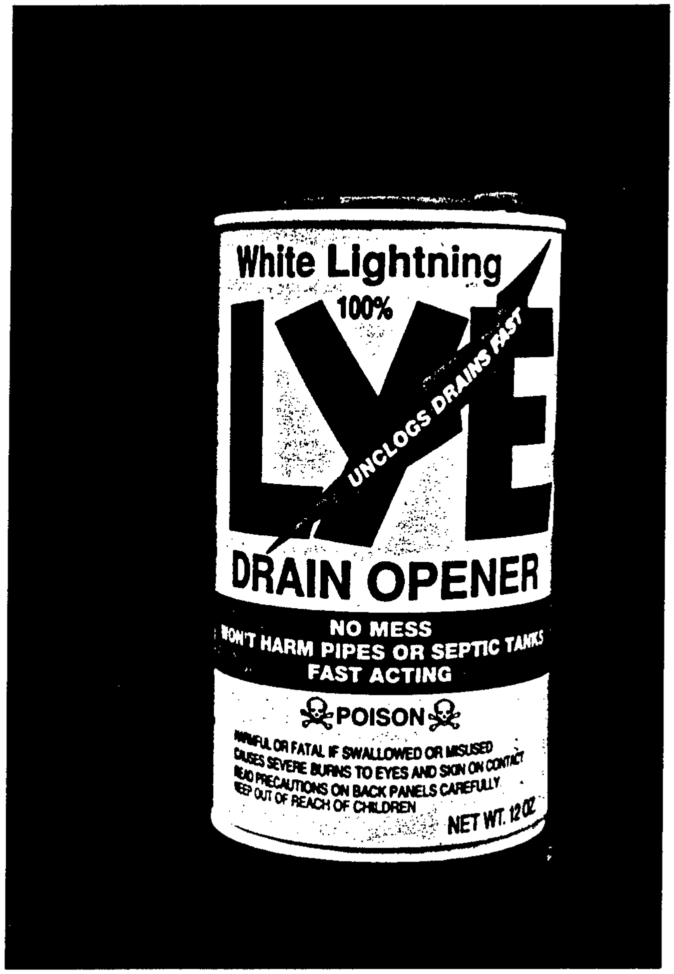

Figure 3.1. *Front panel of fictitious drain opener.*

Development of Experimental Labels

Technique for Analyzing Existing Product Labels. Although human factors professionals are increasingly being asked to "review" a company's warnings and instructions, there are no widely accepted techniques for performing this type of analysis. Instead, human factors professionals typically rely on empirical and theoretical literature, their own research and design experience, and labeling standards and guidelines. To begin to develop a systematic approach for analyzing existing or prototype product usage information and to help develop the labels for this experiment, a method was devised to analyze the exemplar current product label used in this experiment. The technique was dubbed a "Multi-Attribute Analysis" due to the fact that it involves examining various attributes of individual label statements. The basic objective of the analysis was to examine the characteristics of label statements individually and in relation to one another so as to identify potential label problems or, in this case, to identify statements that need to be altered or moved in order to test specific research hypotheses.

The analysis was accomplished by describing and categorizing label statements according to several attributes or dimensions. More specifically, the Multi-Attribute Analysis involved separating the paragraphs of product usage information into individual statements and examining the characteristics of each statement according to a set of attributes or dimensions.

Upon examining a number of product labels and attempting to describe and categorize individual warning and instruction statements, a number of attributes emerged which appeared to be particularly useful for purposes of this experiment. These attributes were: 1) the type of message conveyed by the statement, 2) the procedural explicitness of the statement, 3) the temporal relevance of the statement, 4) whether or not the statement contained an element of the basic level procedure for using the product, and 5) whether or not the statement was presented in chronological order. It should be noted that additional

attributes could be added to the analysis for purposes of evaluating existing or prototype labels or for testing other experimental hypotheses. For example, other attributes applicable to other situations might include: 1) an estimate of the expected cost of complying with a message, 2) the ability to comply with the message, or 3) the ability to read the message during various stages of product use.

Results of Multi-Attribute Analysis. The Multi-Attribute Analysis was performed on a product label similar to that accompanying a commercially available drain opener. This exemplar current product label is shown in Figure 3.2 and the results of the Multi-Attribute Analysis of the label are shown in Table 3.1. As illustrated in Table 3.1, this label is characterized by: 1) statements that are not chronologically ordered and 2) procedurally explicit safety instructions that are temporally relevant during the use of the product but are located in the precautions section.

The Multi-Attribute Analysis was used to identify statements critical to studying the effect of safety instructions relative to usage instructions. The application of the technique is evidenced in the following description of experimental conditions.

Table 3.1

Multi-Attribute Analysis of Drain Opener Product Usage Information

Label Statement	Type of Message	Procedural Explicitness of Message	Temporal Relevance (Before, during, after use)	Element of Basic Level Procedure?	In Chronological Order?
WARNING: USE WHITE LIGHTNING LYE ONLY AS DIRECTED ON THIS LABEL.	Safety Instruction (prescription)	Explicit	Before, during, after use	No	Yes
MISUSE MAY RESULT IN SERIOUS INJURY.	General warning	Non-explicit	Before, during, after use	No	Yes
ALWAYS KEEP OUT OF REACH OF CHILDREN.	Safety Instruction (prescription)	Non-explicit	Before, during, after use	No	Yes
CONTAINS SODIUM HYDROXIDE (LYE).	General warning (to limited audience)	Non-explicit	Before, during, after use	No	Yes
HARMFUL OR FATAL IF SWALLOWED.	General warning	Non-explicit	Before, during, after use	No	Yes
CORROSIVE--CAUSES SEVERE BURNS TO EYES AND SKIN.	General warning	Non-explicit	Before, during, after use	No	Yes
CAN CAUSE BLINDNESS.	General warning	Non-explicit	Before, during, after use	No	Yes
KEEP LYE, AND SOLUTIONS OF LYE, AWAY FROM EYES, SKIN, MOUTH AND CLOTHING.	Safety Instruction (prescription)	Somewhat explicit	Before, during, after use	No	Yes
*Use protective eyewear.	Safety Instruction (prescription)	Explicit	During use	Yes	No
*Wear rubber gloves.	Safety Instruction (prescription)	Explicit	During use	Yes	No
KEEP FACE AWAY FROM CAN AND DRAIN AT ALL TIMES.	Safety Instruction (prescription)	Somewhat explicit	During use	Yes & No	Yes & No
To avoid violent reaction and dangerous splash back which can cause serious burns to skin and eyes:					
- *NEVER USE WITH **HOT WATER** OR **OTHER CHEMICALS** OR **DRAIN CLEANERS** BEFORE, DURING, OR AFTER USING LYE.	Safety Instruction (proscription)	Explicit	Before, during, after use	No	Yes & No
- *NEVER USE A PLUNGER OR PRESSURIZED DRAIN PIPE OPENER DURING OR AFTER USING LYE.	Safety Instruction (proscription)	Explicit	During and after use	No	No
- **NEVER** USE LYE IN TOILET BOWLS, GARBAGE DISPOSALS OR DISHWASHERS.	Safety Instruction (proscription)	Explicit	Before use	No	Yes
In case of spillage from can, sweep into dust pan, empty down nearest working sink drain and flush with COLD water.	Contingency Safety Instruction (error recovery prescription)	Explicit	Before, during, after use	No	Yes
*If lye has hardened in can, do not attempt to remove. Replace cap on top of can and dispose of can.	Contingency Safety Instruction (contingency prescription/proscription)	Explicit	During use (after opening can)	Yes	No
FIRST AID: EYES--Immediately flush eyes thoroughly with running water for 20 minutes. (Contact lenses must be removed immediately before flushing.) **IF SWALLOWED**--Rinse mouth. Then drink one or two glasses of water or milk. DO NOT drink vinegar, citrus juice or other acidic fluids. DO NOT INDUCE VOMITING. **SKIN**--Gently wipe product	Contingency Safety Instructions (error recovery prescriptions and proscriptions)				

Multi-Attribute Analysis of Drain Opener Product Usage Information (continued)

Label Statement	Type of Message	Procedural Explicitness of Message	Temporal Relevance (Before, during, after use)	Element of Basic Level Procedure?	In Chronological Order?
STORAGE AND DISPOSAL: Store on high shelf or in locked cabinet, out of reach of children. Do not transfer lye to any other container or mix with other chemicals. Discard empty can with cap in place into trash container. Do not incinerate.	Safety Instructions (prescriptions/proscriptions re: storage and disposal)				
DIRECTIONS FOR USE:					
*NEVER POUR LYE DIRECTLY FROM CONTAINER INTO DRAIN.	Safety Instruction (prohibition)	Explicit	During use	No	No
*KEEP FACE AWAY FROM CAN AND DRAIN.	Safety Instruction (prescription)	Somewhat explicit	During use	Yes & No	Yes & No
*Use a plastic spoon.	Instruction (property protection prescription)	Explicit	During use	Yes	No
*Do not use an aluminum measuring spoon.	Instruction (property protection prescription)	Explicit	During use	No	No
*Keep lye and solutions away from contact with aluminum utensils, wood, painted surfaces, acrylic or fiberglass, as damage may result.	Instruction (property protection prescription)	Explicit	During use	No	Yes & No
Opening Clogged Drains—Remove any standing water and, if possible, remove drain sieve from sink, washbowl or tub.	Instruction	Explicit	During use	Yes	Yes
Make sure water in drain is cool.	Safety Instruction (prescription)	Somewhat explicit	During use	Yes	Yes
Open can.	Instruction	Somewhat explicit (may require additional inference or processing of text on cap)	During use	Yes	Yes
Add three (3) level tablespoons of lye into drain, one at a time.	Instruction (with safety element)	Explicit	During use	Yes	Yes
Immediately replace cap securely and remove any excess crystals from top of container by gently tapping over drain.	Safety Instruction (prescription)	Explicit	During use	Yes	Yes
Allow 30 minutes for lye to dissolve clog.	Instruction	Explicit	During use	Yes	Yes
If water drains normally, then flush with COLD running water.	Instruction (with safety element)	Explicit	During use	Yes	Yes
If water does not drain or drains slowly, repeat application ONE time only.	Instruction (with safety element)	Explicit	During use	Yes	Yes
DO NOT REPEAT AFTER SECOND APPLICATION, as violent splash back may occur.	Safety Instruction (proscription)	Explicit	During use	Yes	Yes
If water does not drain after second application, CONSULT A PLUMBER.	Instruction (with safety element)	Explicit	After use	No	Yes

Description of Experimental Conditions

In order to study the two presentation factors, four experimental labels were developed. In the first condition, the safety instructions were *partially integrated* into the usage instructions and the usage instructions were presented in a prose format. In the second condition, the safety instructions were *completely separated* from the usage instructions and the usage instructions were again presented in a prose format. In the third condition, the safety instructions were *completely integrated* into the usage instructions and the usage instructions were again presented in a prose format. In the fourth condition, the safety instructions were *completely integrated* into the usage instructions but the usage instructions were presented in a numbered list format. A more complete description of each label condition follows.

Condition 1 -- Current label: Partial integration of safety instructions into usage instructions. As previously described, the label shown in Figure 3.2 was fashioned after a commercially available drain opener. It was modified slightly to allow for the spatial constraints imposed by the other label conditions. Since some safety instructions appear in the directions for use and others are in the precautions section, the current label represents a moderate level of warning integration into the usage instructions. In other words, the warnings are partially separated from the usage instructions.

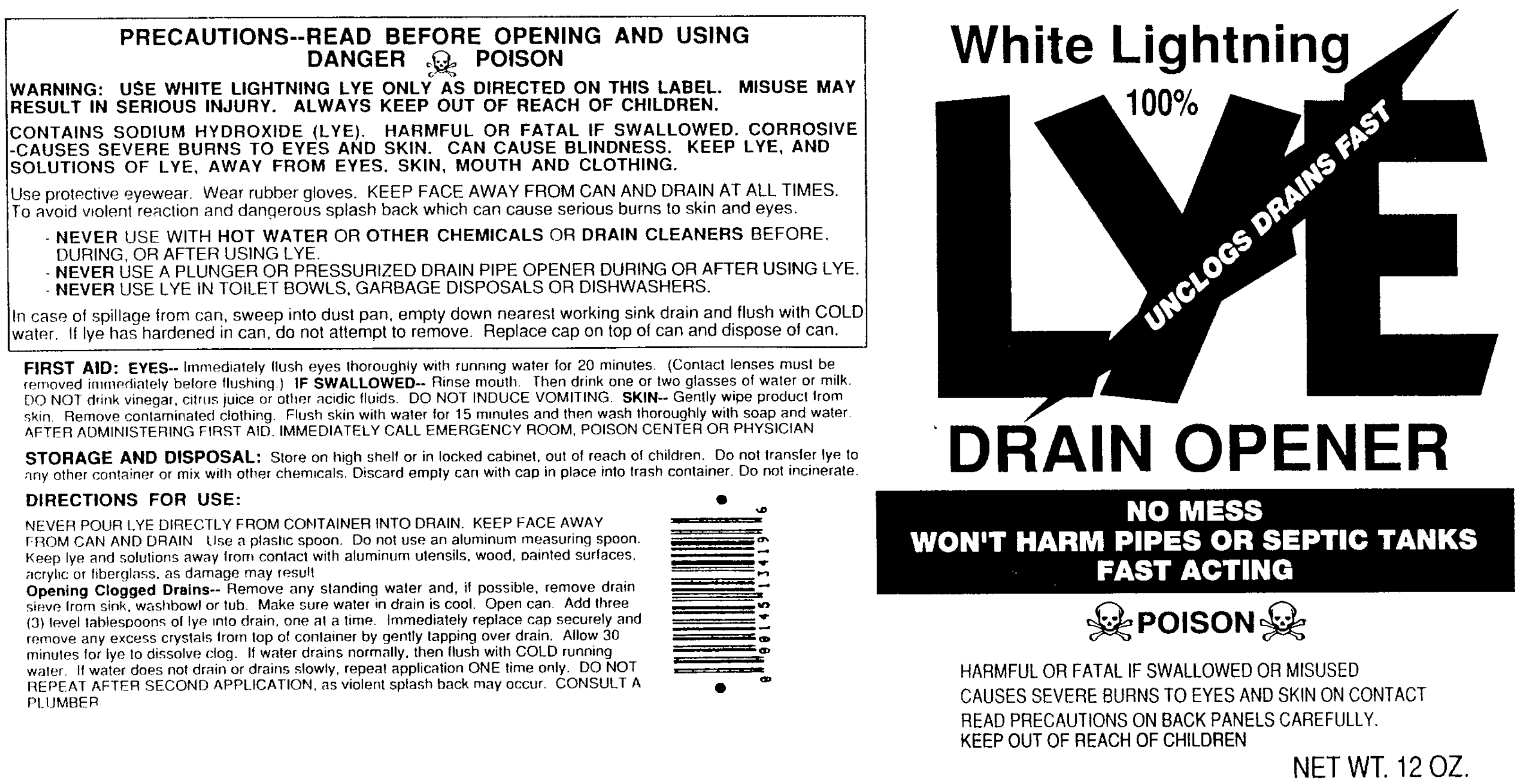

Figure 3.2. *Condition 1: Exemplar current drain opener label in which there is a moderate degree of safety instruction integration into usage instructions.*

Condition 2: Safety instructions completely separate from usage instructions. This condition was designed to be a control condition in which all messages dealing with the safe use of the product appeared in the precautions section and all messages dealing just with the effective use of the product appeared in the directions for use. Thus, the warnings were completely separate from the usage instructions. In order to develop this control condition, the Multi-Attribute Analysis was used to identify all "safety instructions" that currently appear in the directions for use. These statements were:

- Never pour lye directly from container into drain.
- Keep face away from can and drain.
- Make sure water in drain is cool.
- Immediately replace cap securely and remove any excess crystals from top of container by gently tapping over drain.
- Do not repeat after second application, as violent splash back may occur.
- The word "Cold" was removed from the statement, "If water drains normally, then flush with COLD running water."

In addition to all of the safety instructions, all of the "property protection" statements were moved from the directions to the precautions, so that the directions for use contained only that information which was required to perform the task effectively but no information pertaining to personal or property protection. The result is Condition 2 which is shown in Figure 3.3.

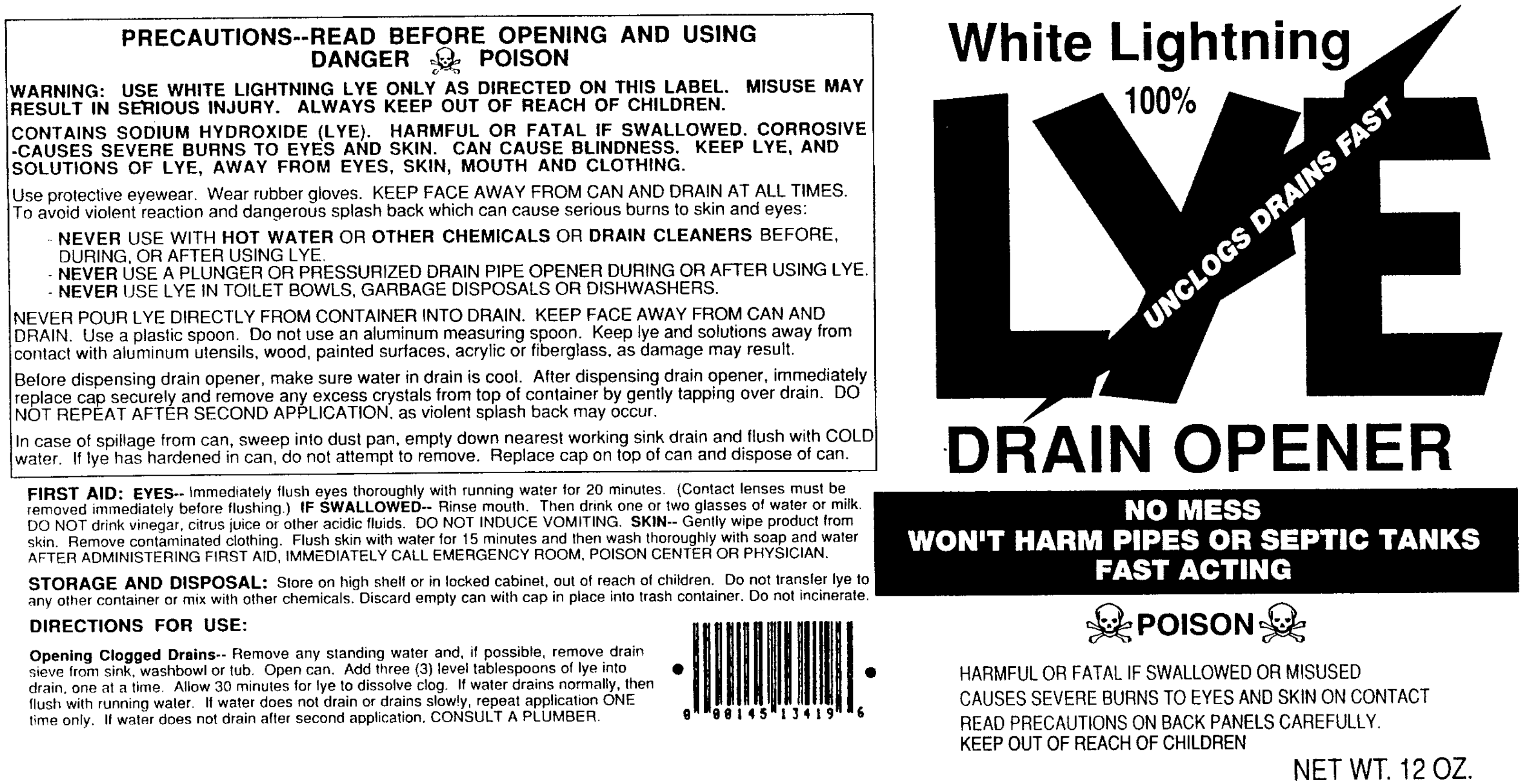

Figure 3.3. *Condition 2: Drain opener label in which safety instructions are completely separate from usage instructions.*

Condition 3: Safety instructions completely integrated (prose format). This condition was designed to provide a complete procedure for the safe *and* effective use of the product by completely integrating the appropriate warnings and instructions. To do this, a rule was devised which would identify those safety related statements that should be integrated with the usage instructions. The rule for including warning messages in the directions for use was as follows:

> If a statement is categorized as a safety instruction that is at least somewhat procedurally explicit and is an element of the basic level procedure or it has particular or exclusive relevance during the use of the product, then it should be integrated into the directions for use.

This rule reflects the underlying assumption and research hypothesis that users are likely to search for information to perform a task and, as a result, they are more likely to process information in the directions for use than information in the precautions section.

The statements that meet the above criteria are marked in Table 3.1 with asterisks at the beginning of each statement. In the precautions section of the label, these statements include:

- Use protective eyewear.
- Wear rubber gloves.
- Never use hot water or other chemicals or drain cleaners before, during, or after using lye.
- Never use a plunger or pressurized drain pipe opener during or after using lye.
- If lye has hardened in can, do not attempt to remove. Replace cap on top of can and dispose of can.

Statements in the directions for use that meet the above criteria include:

- Never pour lye directly from container into drain.
- Keep face away from can and drain.
- Use a plastic spoon.
- Do not use an aluminum measuring spoon.
- Keep lye and solutions of lye away from contact with aluminum utensils, wood, painted surfaces, acrylic or fiberglass, as damage may result.

In addition to simply moving the safety instructions into the usage instructions, the statements were arranged in chronological order. Arranging the statements chronologically was important primarily because the final experimental condition employed a numbered list format. That is, presenting a procedure in a numbered list format seems illogical if the statements themselves are not arranged chronologically. Furthermore, arranging the statements chronologically reduces the cognitive demands on the user by not requiring him/her to construct the proper sequence of actions in memory and then execute it without error. Label Condition 3 is shown in Figure 3.4.

Condition 4: Safety instructions completely integrated (numbered list format). This condition was the same as Condition 3 except that the directions for use were presented in a step-by-step, numbered list format rather than prose format (see Figure 3.5).

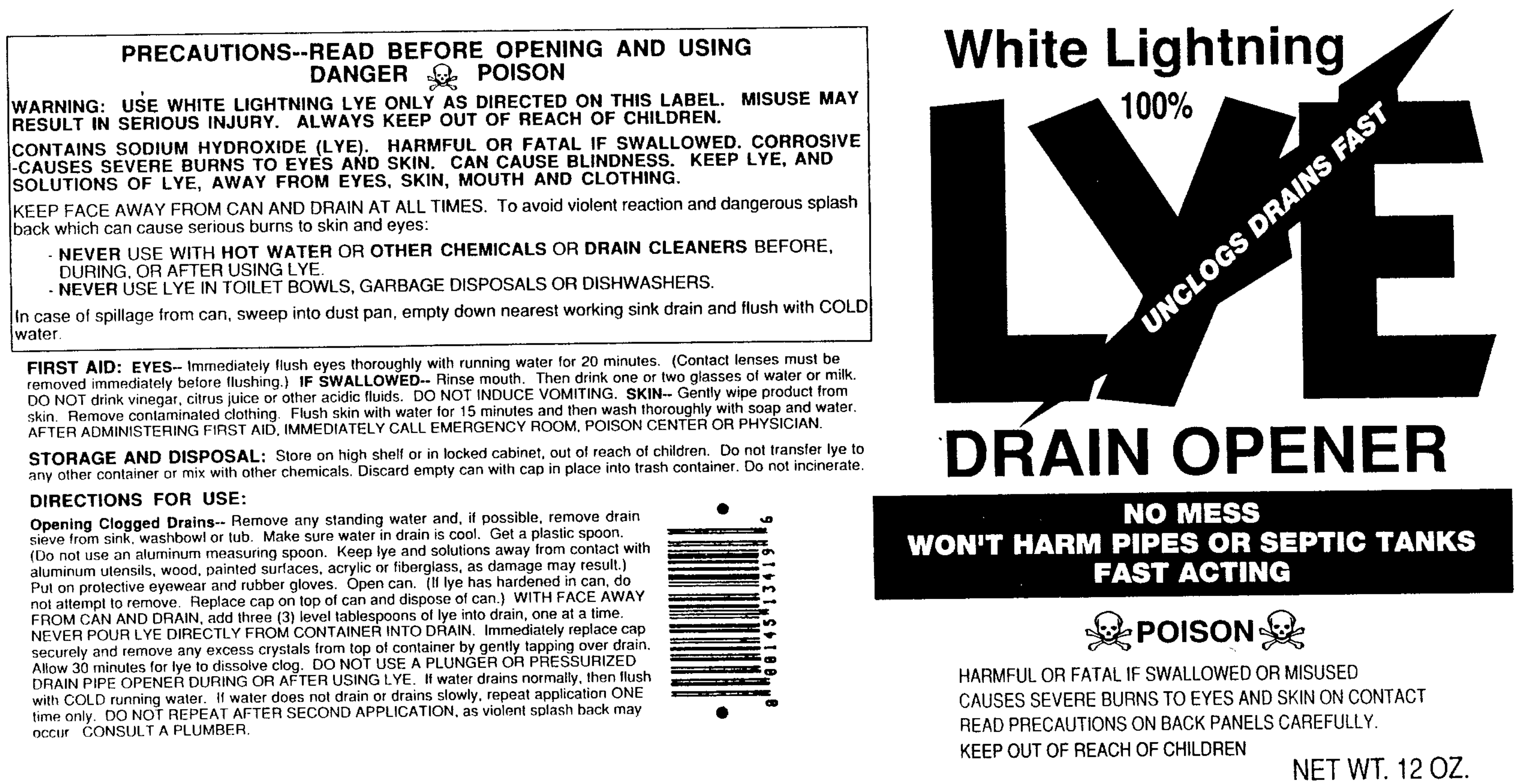

Figure 3.4. *Condition 3: Drain opener label in which safety instructions are completely integrated into usage instructions. Usage instructions presented in prose format.*

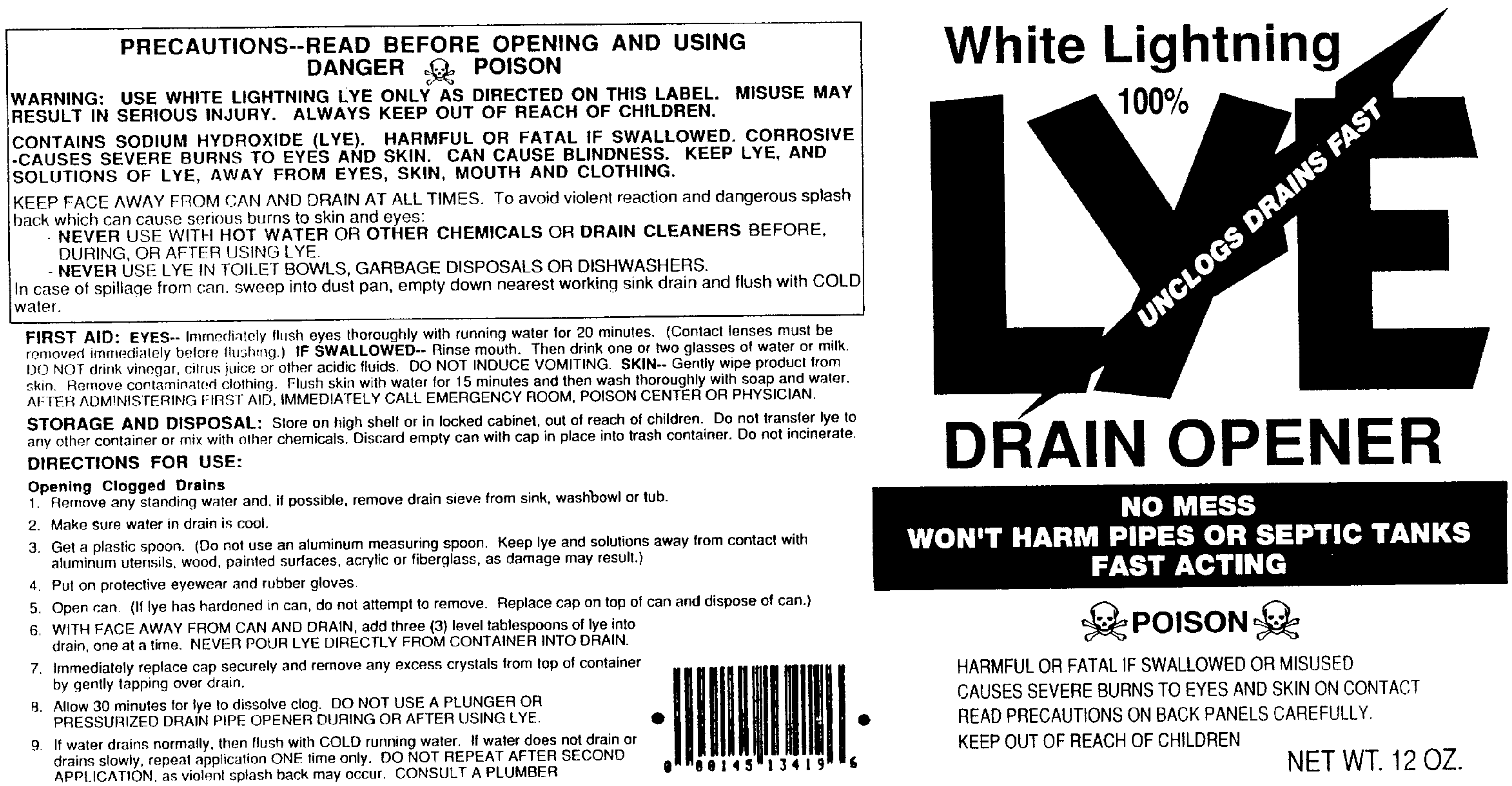

Figure 3.5. *Condition 4: Drain opener label in which safety instructions are completely integrated into usage instructions. Usage instructions presented in numbered list format.*

Summary of Label Design Approach

It is important to note that, although the specific intent of developing alternative label conditions was to investigate the two presentation factors, implicitly this research represents an application and evaluation of a user-oriented, human factors approach to the design of product warnings and instructions. This is in contrast to a "common sense" or established practice approach to designing product safety information. For the sake of clarity, the approach used to modify the drain opener labels was based on the assumption that, for this particular product, users will tend to seek information pertaining to the use of the product to unclog the drain. Thus, it was hypothesized that incorporating safety-critical information into the flow of information that users are likely to process would make the safety-critical information more usable. Such an approach is consistent with Wright's (1980) view that the usability of written information can be increased by designing information to be compatible with the perceptual strategies, conceptual knowledge, and information processing resources of the user. This approach, however, is not consistent with the hypothesis that product users will be specifically seeking safety-related information in the course of using a product to perform a task.

Subjects

Eighty subjects participated in the experiment. Subjects were randomly assigned to one of the four previously described conditions. The vast majority of subjects were selected from a list of undergraduate students who had previously registered their willingness to participate in experiments and the remaining subjects were students who accompanied other subjects to the experimental site. As part of the subject registration process at the university, students indicated whether or not they wore glasses. This information was available to the experimenter prior to recruiting the subjects and allowed for selection of only those people who did not wear glasses. Such a selection criterion was

used to prevent a potential confound between the usage of protective eyewear, as prescribed by the product's label, and the wearing of prescription eyeglasses.

There were 32 males and 48 females. Subjects ranged from 18 to 23 years of age with a mean age of 20.7 years. Example majors for the subjects included: education, economics, engineering, mathematics, psychology, english, music, and business. Subjects were paid $10 for participating.

Experimental Design

The four experimental labels were used to study two presentation factors: location of safety instructions relative to directions for use and presentation format of usage instructions. The "location" factor had three levels: safety instructions completely separated from directions for use, safety instructions partially integrated with directions for use, and safety instructions completely integrated with directions for use. The latter of these three conditions was presented in both prose and numbered list formats in order to assess the effect of presentation format. Thus, the experiment consisted of two between-subjects, single factor experiments.

Dependent measures included behavioral compliance with instructions and warnings and text processing measures such as self-reported reading of instructions, self-reported strategies for processing information, self-reported attention to various label components, and observed viewing times for panels of the container. In addition, subjective ratings of product hazardousness and the reasons for not complying with instructions were obtained. Finally, subject characteristics including age and experience with drain openers were gathered.

Procedure

To preclude subjects from guessing the purpose of the study, subjects were recruited under the guise that the objective of the study was to determine the effect of background music on the performance of household tasks. Once in the kitchen, the experiment began with the experimenter reading the following instructions to the subject:

> To determine the effect of listening to music on the performance of household tasks, we've selected the following situation.
>
> Imagine that this is the kitchen in your apartment and you are preparing to host a birthday party. You have been working all day cleaning to get ready for the party. In addition, you have potted some plants and assembled this plant stand to give to your friend as a birthday present. You've also lit this scented candle to freshen the air prior to your guest's arrival.
>
> With the arrival of your guests about 45 minutes away, you still have a few things to do before they get here. In particular, you need to clean the sink and finish making your friend's birthday present. Finishing the present means applying a coat of water sealant to the wood. Unfortunately, now that you are ready to clean the sink, you discover that the drain is clogged.
>
> What I would like for you to do first is unclog the drain and then apply a coat of water sealant to the plant stand. Finally, you should clean the sink after you have done these two tasks.
>
> You should find everything you need to perform these tasks here in the kitchen. Feel free to open cabinets and drawers to find what you need. If you have any questions feel free to ask me, I'll be working in the next room.
>
> You have been assigned to the control condition which means that you will be performing the tasks with no background music.
>
> To review your tasks one more time, first, unclog the drain, then apply a coat of water sealant to the plant stand, and then clean the sink. You should have plenty of time, so there is no need to feel rushed. Do you have any questions? Let me know when you are finished and we will move to the next phase of the session. You may begin.

The objective of the instructions was to project the subject into a situation of performing a reasonably expected task. This was designed to increase the fidelity of the interaction between the product and user since products are typically thought of as being

used in the larger context of task performance. For example, people typically think of themselves as unclogging a drain rather than using a drain opener and painting rather than using a paint brush. A second reason to frame the subject instructions in the form of distinct tasks was to reduce undue attention to the fictitious products. If the subjects were simply told to use the drain opener they may have been more inclined to alter their normal interaction with the product.

After receiving the instructions, subjects proceeded to use the drain opener to unclog the drain. The experimenter was seated in an adjacent room out of sight of the subject. A hidden camera and video monitor allowed the experimenter to record observations in real-time and to video tape the session. The video tapes were used to measure the amount of time subjects spent viewing various panels of the container.

An important point regarding the procedure is that the subjects were not initially instructed to use a drain opener nor were they told where the drain opener was located. Instead, they were assigned three tasks, one of which was to unclog the drain. This facet of the procedure was incorporated to prevent subjects from sensing that the focus of the experiment was on a particular product as opposed to performing a task.

After dispensing the drain opener, subjects proceeded to apply a coat of water sealer to a wooden plant stand. After beginning to apply the water sealer, the experimenter directed the subject to another room and conducted a structured interview and debriefing (See Appendix B). The experimental tasks took an average of approximately 8 minutes and the subsequent interview and debriefing typically lasted 25 minutes.

Stimulus Materials

Product and labels. The drain opener was provided in a container which formerly held a crystal drain opener. The container was filled with Kosher salt crystals which was highly similar in appearance to lye crystals.

The labels were professionally prepared, printed, and affixed to the cans. To enhance the fidelity of the fictitious product, the label included such details as a bar code (UPC) and the product had an actual price tag.

Experimental workspace. The experiment took place in the kitchen of a house which was located in a residential area a few minutes away from campus (see Figure 3.6). Subjects worked in the kitchen while the experimenter observed from an adjacent room via a hidden video camera and monitor. The kitchen was equipped with a dishwasher, refrigerator, cabinets, counter space along two walls, and a double basin sink. One of the drains in the sink was purposely clogged and approximately six cups of water was standing in the basin.

Consistent with the instructions and cover story provided to the subjects, there were birthday party supplies (e.g., paper plates, candles, napkins, table cloth, and plastic ware) laid out on one of the counters. There was also a portable radio on the counter to add to the guise that the experiment was intended to study the effect of background music on the performance of household tasks. An empty plastic mug was adjacent to the clogged sink which allowed subjects to bail the standing water. In addition, plastic and metal spoons for dispensing the lye were positioned on one of the counters and in a silverware draw beneath the counter.

The drain opener was placed in the front of the cabinet under the sink (see Figure 3.7). Protective gloves and goggles were adjacent to the drain opener. In addition, a pair of rubber-coated gardening gloves was placed on the counter beside the sink and next to a small bag of potting soil and two potted plants. Two sizes of each pair of gloves were used, a smaller size for female subjects and a larger size for male subjects. The protective equipment was made as visible and accessible to the subjects as possible in order to minimize the cost of complying with safety instructions, which has been found to be an

important determinant of compliance in other behavioral studies (Dingus, Hathaway, and Hunn, 1991; Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, and Laughery, 1987).

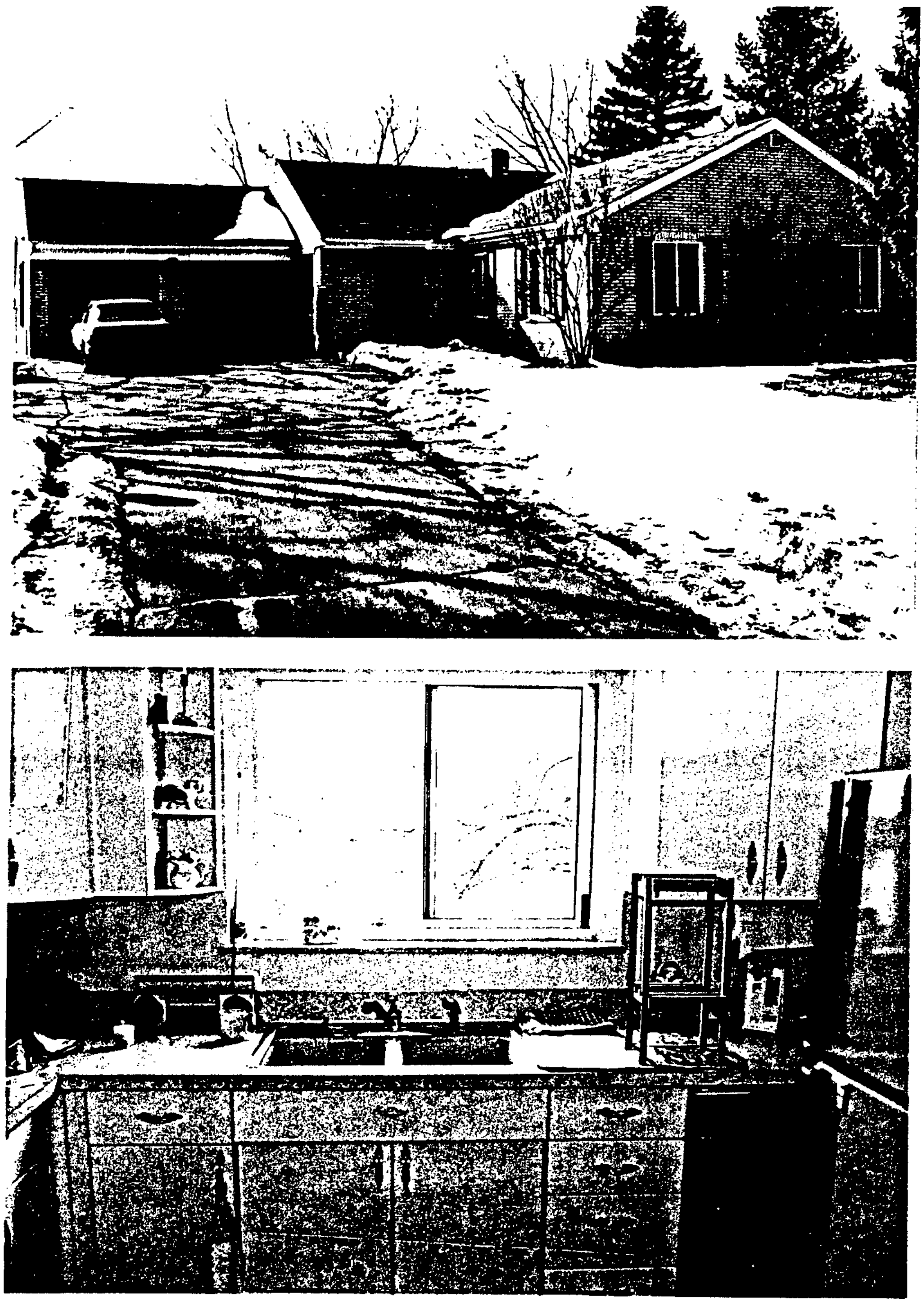

Figure 3.6. *Experimental setting -- Residence and kitchen within residence where experiment took place.*

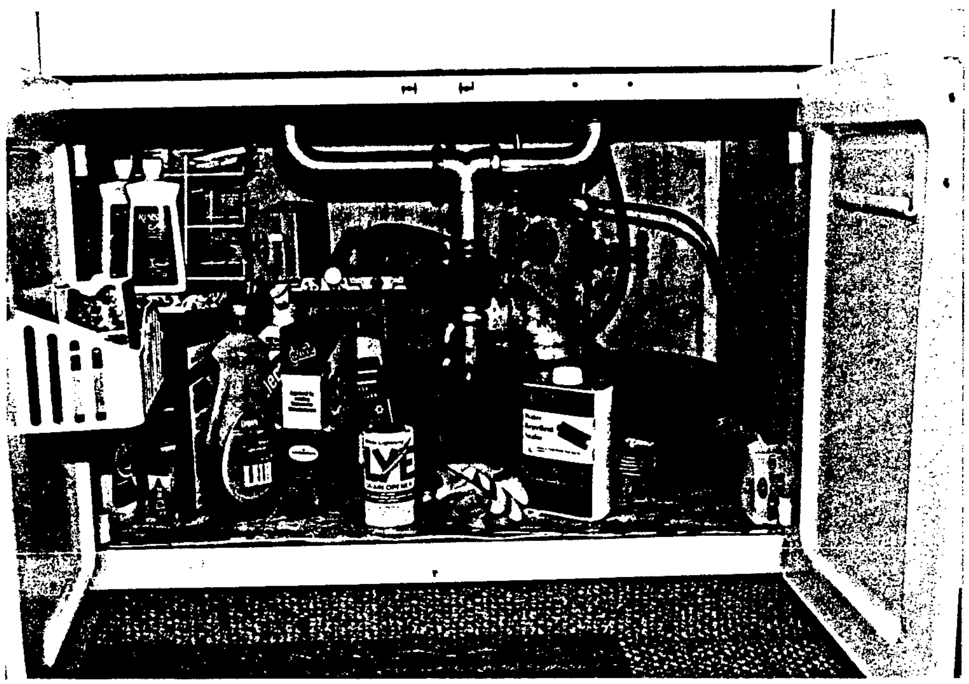

Figure 3.7. *Location of drain opener in cabinet beneath sink.*

Results

Compliance Data

Compliance rates across conditions. Through hidden camera observation and post-task interviews, behavioral compliance with several pertinent safety and usage instructions was measured. Table 3.2 lists the five safety instructions and three nonsafety instructions along with the compliance criterion for each. The percentage of subjects in each condition complying with the safety instructions is shown in Figure 3.8 and the percentage of subjects complying with each of the nonsafety instructions is shown in Figure 3.9.

Table 3.2

Safety and usage instructions and their accompanying compliance criteria.

Instruction	*Criterion for Compliance*
1 Use protective eyewear*	Wear goggles while dispensing lye
2. Wear rubber gloves*	Wear gloves while dispensing lye
3. Make sure water in drain is cool*	Check temperature of water in basin before dispensing lye (self report)
4. Add three level tablespoons of lye*	Dispense less than 35 grams of product
5. Immediately replace cap securely*	"Snap" cap into place before end of session
6. Use a plastic spoon**	Dispense lye with a plastic spoon
7. Remove any standing water**	Bail standing water from sink before dispensing lye
8. Remove drain sieve from sink**	Remove drain sieve from sink before dispensing lye

* Safety instruction
** Nonsafety instruction

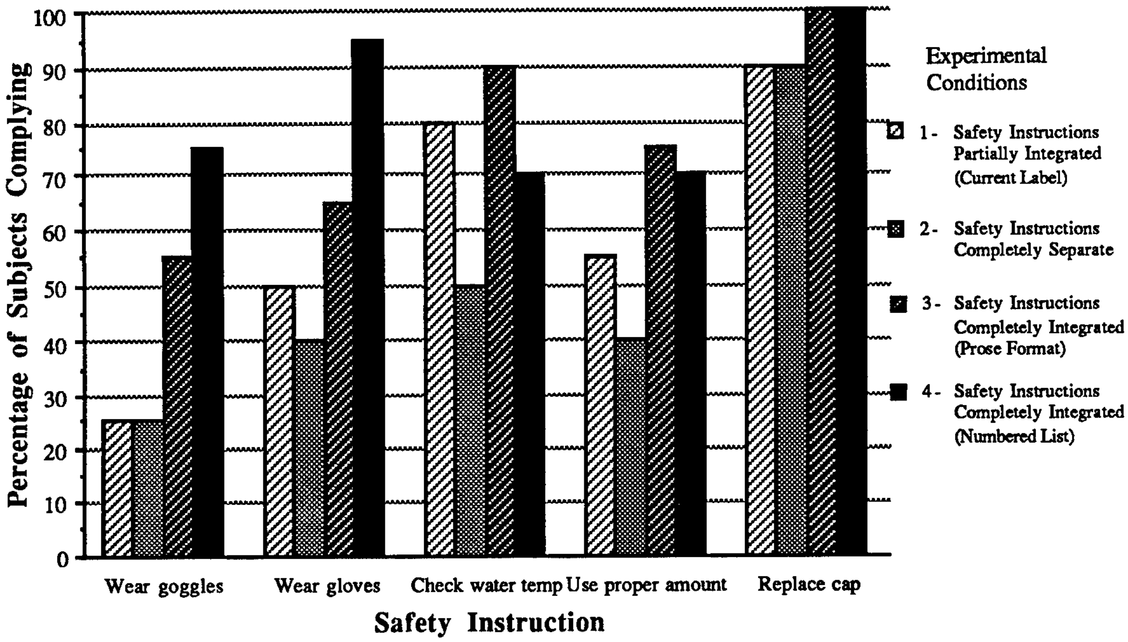

Figure 3.8 *Percentage of subjects complying with safety instructions.*

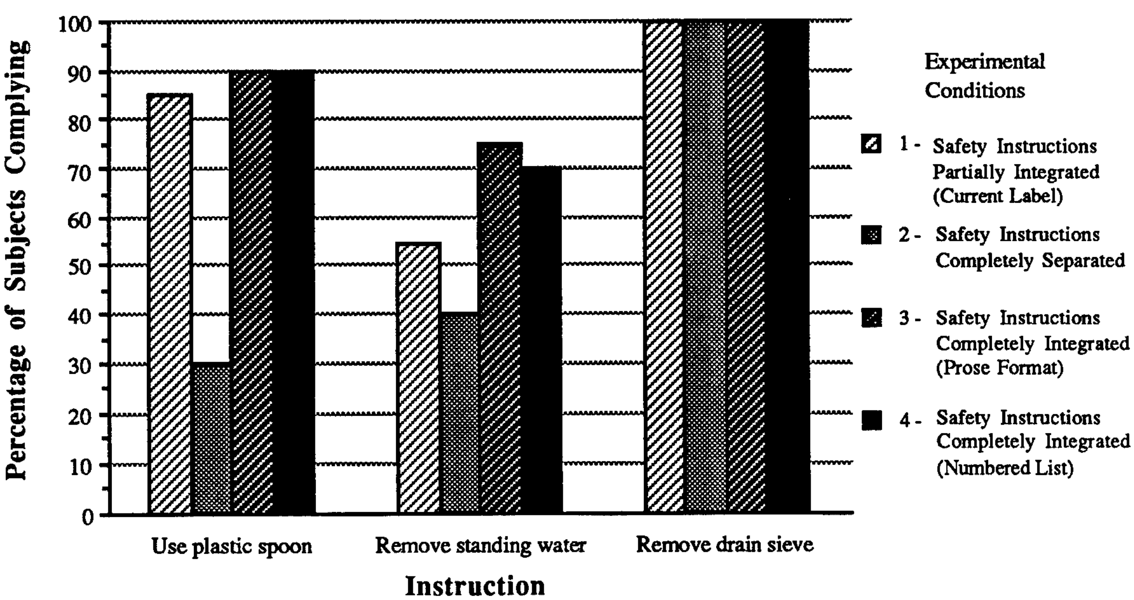

Figure 3.9 *Percentage of subjects complying with nonsafety instructions.*

Effect of safety instruction location. To determine the effect of safety instruction location relative to usage instructions, subject responses to each instruction were pooled from all conditions in which the instruction appeared in a particular location (i.e., precautions section versus directions for use). Table 3.3 shows the proportion of subjects complying with each safety instruction when it was presented separately from the directions and when it was included in the directions.

Table 3.3

Percentage of subjects complying with each instruction by location of instruction.

	Location of Instruction	
Instruction	*Precautions Section*	*Directions for Use Section*
Use protective eyewear	25% (n=40)	65% (n=40)
Wear rubber gloves	45% (n=40)	80% (n=40)
Make sure water in drain is cool	50% (n=20)	80% (n=60)
Immediately replace cap securely	90% (n=20)	97% (n=60)
Use a plastic spoon*	30% (n=20)	88% (n=60)

* Only nonsafety instruction that appeared in both the precautions section and directions for use.

Chi-square tests were conducted to analyze the effect of location on compliance with each safety instruction. The effect of location was significant for three of the four safety instructions: use protective eyewear, χ^2 (1) = 12.9, N = 80, $p < 0.01$, wear rubber

gloves, χ^2 (1) = 10.5, N = 80, $p < 0.01$, and make sure water in drain is cool, χ^2 (1) = 6.8, N = 80, $p < 0.01$. Compliance with these safety instructions was significantly greater when they appeared in the directions for use than when they appeared in the precautions section. Compliance with the nonsafety instruction to use a plastic spoon was also significantly greater when the instruction was included in the directions for use than when it appeared in the precautions, χ^2 (1) = 26.4, N = 80, $p < 0.01$. The instruction to immediately replace the cap was the only one that did not yield a significant effect of location ($p > 0.10$). Interestingly, the proportion of subjects *complying* with this instruction was higher than the proportion of subjects who reported *reading* this instruction. Thus, as one might expect, replacing the cap after using the drain opener was a behavior that was highly likely to occur regardless of the location of the written instruction to do so. Averaging across the five instructions shown in Table 3.3, moving an instruction from the precautions to the directions for use increased the compliance rate from 48% to 82%.

Another means of assessing the effect of safety instruction location relative to usage instructions is to consider the overall behavioral effectiveness of each of the experimental labels. To do this, a composite measure or Safety Instruction Compliance Score was constructed by summing the number of safety instructions each subject followed. Thus, equal weight was given to each safety instruction. In addition to the Safety Instruction Compliance Score, a Safety and Usage Instruction Compliance Score was constructed by totalling the compliance with all instructions (see Table 3.2).

Table 3.4 shows the mean values for these two compliance scores for each level of safety instruction integration into usage instructions. Note that, in Conditions 3 and 4, the safety instructions were completely integrated into the directions for use. This table illustrates that, on average, subjects complied with more than 80% of the safety instructions (4.25 out of 5) when the safety instructions were completely integrated into the directions

for use. However, for the lower levels of safety instruction integration, subjects complied with approximately 60% of the safety instructions (i.e., 2.95 and 3.30 out of 5).

Table 3.4

Mean compliance scores for different levels of safety instruction integration into usage instructions.

Degree of Safety Instruction Integration Into Usage Instructions	*Mean Compliance Score*	
	Safety Instruction Compliance Score (Max. Score = 5)	*Safety and Usage Instruction Compliance Score (Max. Score = 8)*
No Integration (Condition 2)	2.95 (0.33)	4.65 (0.41)
Partial Integration (Condition 1)	3.30 (0.24)	5.70 (0.35)
Complete Integration (Conditions 3 and 4)	4.25 (0.15)	6.88 (0.20)

Standard errors appear in parentheses.

An analysis of variance was conducted using the compliance scores as dependent variables and the level of safety integration as the independent variable. Increasing the level of safety instruction integration significantly increased the Safety Instruction Compliance Score, $F(2,77) = 10.57$, $p < 0.01$, and the Safety and Usage Instruction Compliance Score $F(2,77) = 15.13$, $p < 0.01$. The Scheffe F-test was used to evaluate the significance of all possible differences between the pairs of means for each composite score. It was found that both the Safety Instruction Compliance Score and the Safety and Usage Compliance Score were significantly greater when the safety instructions were completely integrated in the directions for use than in the no integration and partial integration conditions ($p < 0.05$). However, the scores did not differ significantly for the no integration and partial integration conditions ($p > 0.05$). In summary, the labels in which

the safety instructions were completely integrated into the directions for use were significantly more effective in terms of warning compliance than those that presented the safety instructions separately from the directions for use.

Effect of presentation format. Recall that Conditions 3 and 4 both had safety instructions completely integrated into the directions for use, but Condition 3 presented the instructions in a prose format whereas Condition 4 did so in a numbered list format. Figures 3.8 and 3.9 show the percentage of subjects who complied with the safety instructions and nonsafety instructions for the prose format (Condition 3) and the numbered list format (Condition 4). Planned comparisons between the compliance rates for each instruction were conducted using chi-square tests. The numbered list format yielded significantly higher compliance only for the instruction to wear rubber gloves, $\chi^2(1) = 5.63$, $N = 40$, $p < 0.05$. For the remaining seven instructions, compliance rates did not differ significantly between the prose and numbered list formats ($p > 0.10$).

The previously described composite compliance scores were formed for the two presentation formats and t-tests were conducted. The compliance scores did not differ significantly between the prose and numbered list formats ($p > 0.10$).

In summary, presenting the directions for use in a numbered list format rather than a prose format increased the compliance rate for only one safety instruction and did not significantly increase the overall safety and usage compliance scores. Thus, the effect of presentation format was significant on a small scale, but did not produce different compliance rates across multiple measures of compliance.

Text Processing Data

Overall self-reported reading of instructions. During the post-task interview, subjects were asked to explain why they did or did not perform certain actions while using the drain opener. As part of this questioning, subjects were queried as to whether or not

they read the instructions listed in Table 3.2. The percentage of subjects who reported reading each of the five safety instructions is shown in Figure 3.10 and the reading rates for the three nonsafety instructions are shown in Figure 3.11.

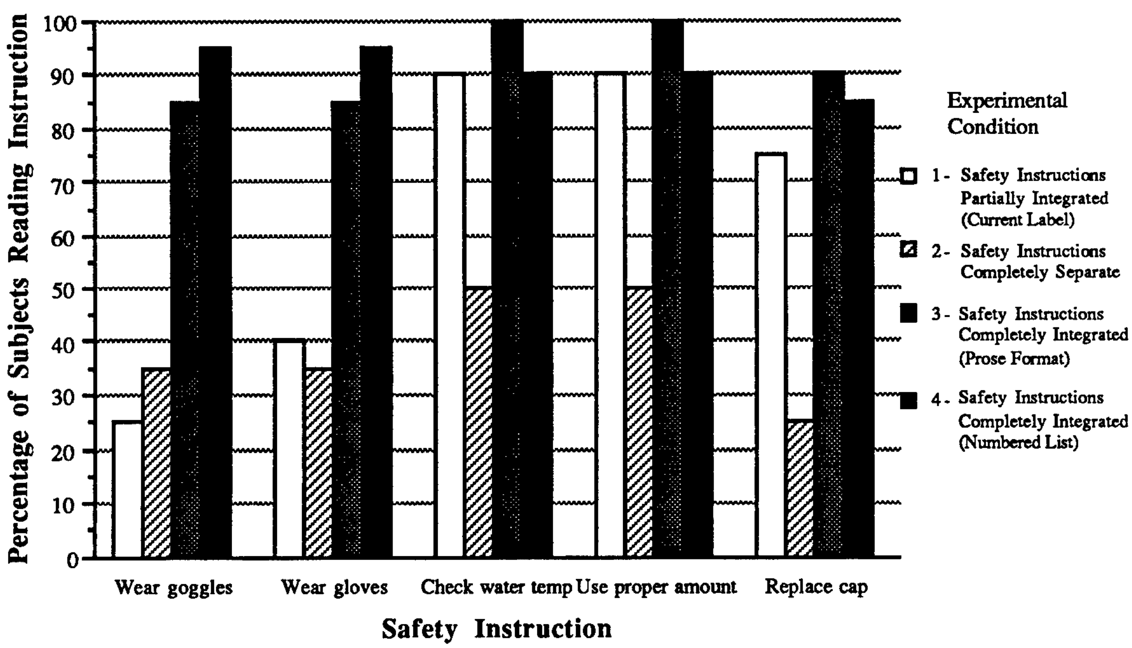

Figure 3.10 *Percentage of subjects in each condition who reported reading each safety instruction.*

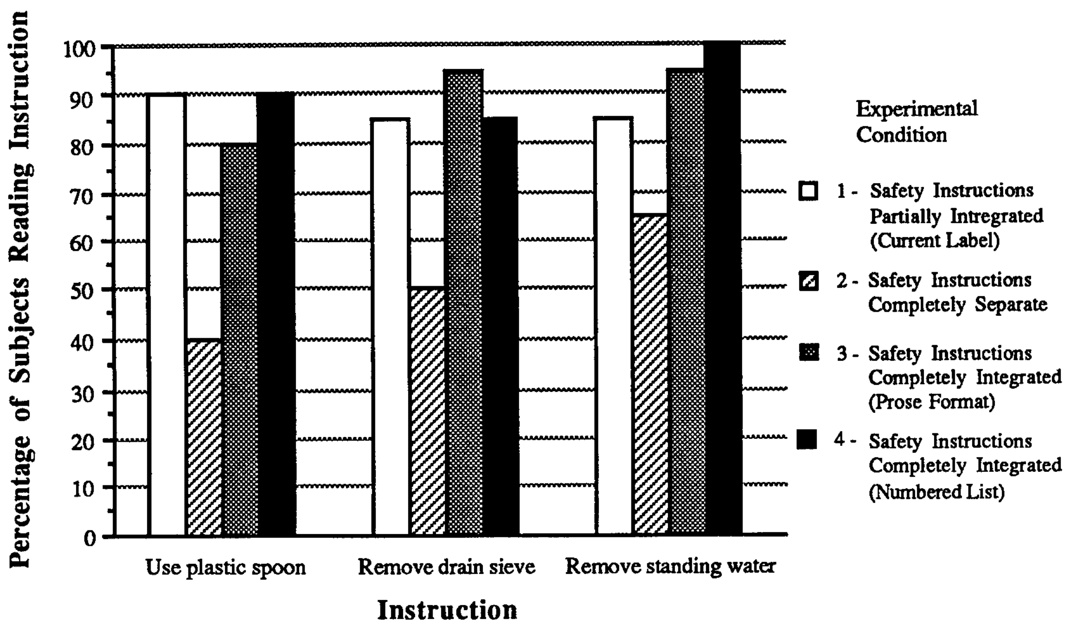

Figure 3.11 *Percentage of subjects in each condition who reported reading each nonsafety instruction.*

Effect of location on reading task-specific safety instructions. As with the compliance data, the responses were partitioned according to the location of the instruction (precautions section versus directions for use). Table 3.5 shows the percentage of subjects who reported reading each instruction when it appeared in the precautions and when it appeared in the directions for use.

Chi-square tests were conducted to determine the effect of location on the attention to each instruction. The effect of location was found to be significant for all four safety instructions. That is, a significantly greater proportion of subjects reported reading each of the safety instructions when they appeared in the directions for use as opposed to the precautions: use protective eyewear, χ^2 (1) = 30, N = 80, $p < 0.01$; wear rubber gloves, χ^2 (1) = 23.85, N = 80, $p < 0.01$; make sure water in drain is cool, χ^2 (1) = 19.51, N = 80, $p < 0.01$; and immediately replace cap securely, χ^2 (1) = 23.76, N = 80, $p < 0.01$. The percentage of subjects who reported reading the nonsafety instruction to use a plastic

spoon was also significantly greater when the instruction appeared in the directions for use rather than the precautions, $\chi^2(1) = 17.42$, $N = 80$, $p < 0.01$. Averaging across the five instructions shown in Table 3.5, moving an instruction from the precautions to the directions for use increased the percentage of subjects reading the instruction from 37% to 89%.

Table 3.5

Percentage of subjects who reported reading each instruction by location of instruction.

	Location of Instruction	
Instruction	*Precautions Section*	*Directions for Use Section*
Use protective eyewear	30% (n=40)	90% (n=40)
Wear rubber gloves	38% (n=40)	90% (n=40)
Make sure water in drain is cool	50% (n=20)	93% (n=60)
Immediately replace cap securely	25% (n=20)	83% (n=60)
Use a plastic spoon*	40% (n=20)	87% (n=60)

* Only nonsafety instruction that appeared in both the precautions section and directions for use.

As with the compliance data, another way to assess to the effect of safety instruction location is to construct an overall measure of label reading for different levels of safety instruction integration into the directions for use. Two composite reading scores were constructed in the same manner as the previously described composite scores of behavioral compliance. A Safety Instruction Reading Score was constructed by totalling

the number of safety instructions read and a Safety and Usage Instruction Reading Score was constructed by totalling the number of safety and nonsafety instructions read (see Table 3.2 for list of instructions). The mean values for each of these composite reading scores are shown in Table 3.6 for the three levels of safety instruction integration into the usage instructions. This table illustrates that, on average, subjects read more than 90% of the safety instructions (4.6 out of 5) when the safety instructions were completely integrated into the directions for use. However, when the safety instructions were only partially integrated with the directions for use, subjects read an average of 64% of the safety instructions and, when the safety instructions were completely separate from the directions for use, subjects read an average of 44% of the safety instructions.

Table 3.6

Mean reading scores for different levels of safety instruction integration into usage instructions.

	Mean Reading Score	
Degree of Safety Instruction Integration Into Usage Instructions	*Safety Instruction Reading Score (Max. Score = 5)*	*Safety and Usage Instruction Reading Score (Max. Score = 8)*
No Integration (Condition 2)	2.20 (0.33)	3.70 (0.45)
Partial Integration (Condition 1)	3.20 (0.28)	5.75 (0.38)
Complete Integration (Conditions 3 and 4)	4.60 (0.13)	7.3 (0.18)

Standard errors appear in parentheses.

An analysis of variance was conducted using the composite reading scores as dependent variables and the level of safety instruction integration as the independent variable. Increasing the level of safety instruction integration significantly increased the

Safety Instruction Reading Score, $F(2,77) = 32.97$, $p < 0.01$, and the Safety and Usage Instruction Reading Score, $F(2,77) = 36.87$, $p < 0.01$. The Scheffe F-test was used to evaluate the significance of all possible differences between the pairs of means for each composite score. It was found that both the Safety Instruction Reading Score and the Safety and Usage Reading Score were significantly greater in the completely integrated conditions than in the no integration and partial integration conditions ($p < 0.05$), and that both composite reading scores were significantly greater in the partial integration condition than in the no integration condition ($p < 0.05$). Thus, increasing the level of safety instruction integration with the directions for use significantly increased the composite reading scores.

Effect of location on attention to other warnings. In addition to the task-specific instructions, subjects were asked about three other warnings that appeared on the drain opener label. These warnings were: 1) Never use lye in toilet bowls, 2) If lye has hardened in the can, do not attempt to remove -- Replace cap on top of can and dispose of can, and 3) Never use a plunger or pressurized drain pipe opener during or after using lye. Because the latter two warnings were identified as part of a complete procedure for the safe and effective use of the product, they were included in the directions for use in Conditions 3 and 4.

To determine subjects' knowledge regarding these three warnings, subjects were asked the following questions during the post-task interview:

1. According to the label, is this product suitable for use in unclogging a toilet?
2. According to the label, what should you do if you are getting ready to use the drain opener and you discover that it has hardened in the can?
3. According to the label, when using the drain opener, when is an appropriate time to use a plunger?

Answers to these questions provide a measure of incidental processing of information that was not immediately relevant to the task at hand. Although knowledge of these warnings was not pertinent to this particular task, user processing of the warnings is important to the formation of complete and safe rules of product use that are likely to be invoked during subsequent use of the product.

The percentage of subjects correctly answering each of these questions is shown in Table 3.7. This table provides the percentage of correct responses when the warnings appeared in the precautions and in the directions for use. Note that the warning to never use lye in toilet bowls did not appear in the directions for use because it was not considered to be an element of a safe and effective *procedure* for using the product.

Table 3.7

Percentage of subjects correctly answering questions regarding three warnings not pertinent to the experimental task. (Responses are shown for each warning location and presentation format.)

	Percentage of Correct Responses			
	Location of Accompanying Warning		*Presentation Format*	
Question	*Precautions*	*Directions*	*Prose*	*Numbered List*
Is product suitable for use in unclogging a toilet?	10% (n=80)	--	10% (n=80)	--
What to do if lye has hardened in the can?	5% (n=40)	58% (n=40)	65% (n=20)	50% (n=20)
When is an appropriate time to use a plunger?	20% (n=40)	60% (n=40)	55% (n=20)	65% (n=20)

Chi-square tests were conducted to determine the effect of warning location on the proportion of subjects correctly answering the questions in Table 3.7. The effect of

warning location was significant for both the "hardened lye" warning, χ^2 (1) = 25.66, N = 80, $p < 0.01$, and the "plunger" warning, χ^2 (1) = 13.33, N = 80, $p < 0.01$. On average, the percentage of correct responses to questions regarding these two warnings increased from 13% to 59% when the warnings were moved from the precautions to the directions for use.

Effect of presentation format on reading task-specific instructions. Figures 3.10 and 3.11 show the percentage of subjects who read the safety instructions and nonsafety instructions for both prose format (Condition 3) and numbered list format (Condition 4). Planned comparisons between the reading rates for each instruction were conducted using chi-square tests. No significant differences were found ($p > 0.10$). As one might expect, the composite reading scores for the prose and numbered list formats also did not differ significantly ($p > 0.10$). In fact, the mean Safety Instruction Reading Score was the same for both presentation formats (M = 4.6). Thus, the presentation format of the usage instructions did not significantly affect the proportion of subjects reading individual safety or usage instructions in the directions for use nor did it affect the composite reading scores.

Effect of presentation format on attention to other warnings. For each presentation format, Table 3.7 shows the percentage of subjects who correctly answered questions regarding the three warnings that were not directly related to the experimental task. Note that the warning regarding use of lye in toilet bowls always appeared in a prose format in the precautions section. Using chi-square tests, the effect of presentation format was not found to be significant for either of the warnings ($p > 0.10$). Considering Table 3.7 in total, the location of the warning relative to the usage instructions is clearly the more important of the two presentation factors examined in this experiment, in terms of incidental attention to warnings not specifically related to the task at hand.

Information processing strategies. To gain an understanding of the strategies subjects used to process label information during use of the drain opener, subjects were asked two questions regarding the back panel of the container. First, those subjects who

read some of the information, as opposed to all or none, were asked, "Apparently you selected certain portions of the back of the label to read. How did you decide what information to read and what information not to read?" This open-ended question was directed toward understanding what information users were seeking and to provide general information about what and how text was filtered out during the processing of the label. The responses to this question are shown in Table 3.8. Six subjects were not asked this question; four of these subjects reportedly read all of the back label and the other two read none of it.

The responses in Table 3.8 illustrate that, for the majority of subjects, the strategy for processing information on the back of the container was to find information pertaining to the effective use of the product as opposed to locating and reading product safety information that did not have a direct bearing on task accomplishment. In fact, combining responses A, B, C, D, and H in Table 3.8, a total of 63 subjects (85%) indicated that they were searching primarily for information on how to use the product. In contrast, only one subject indicated that the decision to read or not read portions of the back of the label was guided by a desire for information to prevent injuries and to a lesser extent by a desire to obtain directions for use, and five subjects (7%) indicated that they were searching for a combination of information to use the product and prevent injury.

Another interesting result shown in Table 3.8 is that 13 subjects searched primarily for the directions for use and then went back to the read/skim the precautionary information. This is interesting in light of the fact that the directions for use appeared at the bottom of the back panel of the label whereas the precautions appeared at the very top of the panel. This finding, combined with the other responses, illustrates that subjects were generally not reading the labeling in the same manner as they would typically read a book or other type of narrative text.

Table 3.8

Distribution of responses to the question: How did you decide what information to read and what information not to read [on the back of the label]?

Response	*No. of Respondents (N = 74)*
A. Searched primarily for directions for use/information to use product.	36
B. Searched primarily for directions for use then went back to read/skim precautionary information.	13
C. Searched primarily for directions for use and was drawn to prominent precautionary information (i.e., bold, red, or capitalized text).	7
D. Searched primarily for directions for use and glanced at/skimmed other information during search.	6
E. Searched for information on how to use product and prevent injury.	5
F. Read information in prominent print (i.e., bold or red text) then directions for use.	3
G. Searched primarily for information to prevent injuries and then for less important directions for use.	1
H. Searched primarily for directions then went back to read first aid information.	1
I. Other	2

The second question regarding subject strategies for using label information was as follows:

> How would you describe the way you used the information on the back of the drain opener? Did you:
>
> a. Read a sentence or two and then perform an action;
>
> b. Did you read the majority of the information first, then go back and read a sentence or two and perform an action;
>
> c. Did you refer to the label only when you were unsure of what to do;
>
> d. Or what?

This question was asked of the 78 subjects who reportedly read some or all of the information on the back of the label. Table 3.9 shows the distribution of responses to this question for each label condition and the total number of responses for all four conditions.

Table 3.9

Distribution of responses to the question: How would you describe the way you used the information on the back of the drain opener?

Response	*No. of Respondents (N = 78)*	*Frequency of Response For Each Label Condition*			
		1	*2*	*3*	*4*
Read the majority of the information first, then went back and read a sentence or two and performed an action	49	70%	45%	70%	60%
Read information then performed the task/used the product	16	10%	30%	10%	30%
Read a sentence or two and then performed an action	10	15%	5%	20%	10%
Referred to the label only when unsure of what to do	2	5%	5%	0%	0%
Other	1	0%	5%	0%	0%

There are several noteworthy results shown in this table. First, across the four conditions, 49 subjects (63%) indicated that they read the majority of information first, then went back and read a sentence or two and performed an action. Second, in Condition 2 where the directions for use section was the shortest (it contained no information on personal or property protection), 45% of the subjects indicated that they read the majority of information first, then went back and read a sentence or two and performed an action and 30% reported that they read the information first, then performed the task. At first glance, these results are not surprising. However, the results are surprising in light of the response to Condition 4 in which the directions for use contained the entire procedure for safe and effective use of the product and was presented in a numbered list format.

Although Condition 4 appears to be the most amenable to "read one instruction, perform an action," only 10% of the subjects reported doing this, and like Condition 1, 30% read the information first then performed the entire task.

A final point regarding the results in Table 3.9 is that the effect of presentation format can be assessed by comparing the responses to Conditions 3 and 4. Using the chi-square test, it was found that presenting the usage instructions in a numbered list format versus a prose format did not significantly affect how subjects used the information ($p > 0.10$). Thus, the presentation format did not influence the use of the instructions in the hypothesized manner.

Self-reported attention to label components. Another means of assessing users' processing of the label information was to ask the subjects to describe the amount of information they read on the front, back, and top panels of the drain opener container. A seven-point scale with verbal anchors ranging from reading none of the information to all of the information was used. Using the same scale, subjects were asked to describe the amount of information they read in each section on the back of the label (i.e., precautions, first aid, storage and disposal, and directions for use). The mean ratings for each panel of the container and for each section of the back of the label are shown in Figure 3.12.

This figure illustrates that the reading rating varied considerably across panels of the container and sections of the back panel, but there was relatively little variation between label conditions for a given label panel or section. Indeed, using the Kruskal-Wallis test (McClave and Dietrich, 1982), the variation in reading ratings between label conditions was found to be statistically nonsignificant for all of the panels and sections of the back panel ($p > 0.10$). Thus, neither presentation format nor warning location significantly affected the reading ratings for the panels of the container or sections within the back panel.

Because the reading rating did not differ significantly across experimental conditions, the responses were collapsed across conditions to assess the differences in reading ratings between the different panels. Using the Friedman test (McClave and

Dietrich, 1982), the difference between reading ratings for the three panels was assessed. The test was significant, $\chi_r(2) = 74.11$, $p < 0.01$, indicating that reading ratings for at least two of the panels differed significantly. Pairwise comparisons of the reading ratings were then conducted using the Wilcoxon signed-rank test. The reading ratings for the back and top panels did not differ significantly from one another. However, the ratings for both these panels were significantly higher than for the front panel ($p < 0.01$ for both tests).

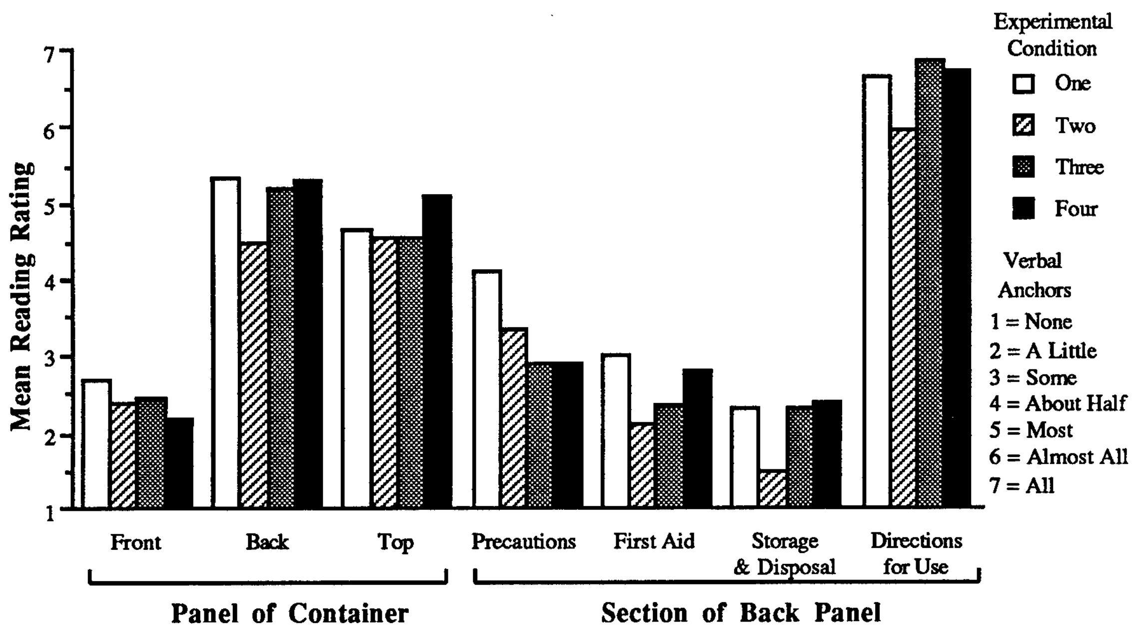

Figure 3.12 *Mean reading ratings for each panel of the container and each section of the back of the label.*

With regard to the sections on the back of the label, the Friedman test found that the reading ratings for at least two sections differed significantly, $\chi_r(3) = 138.5$, $p < 0.01$. Using the Wilcoxon signed-rank test, all pairwise comparisons between the section ratings were found to be significant ($p < 0.05$ for the comparison between first aid and storage and disposal sections, and $p < 0.01$ for the remaining comparisons). Thus, the reported proportion of information read was highest for the directions for use section ($M = 6.54$),

followed by the precautions sections ($M = 3.13$), then the first aid section ($M = 2.56$), and finally the storage and disposal section ($M = 2.13$).

Observed viewing times for panels of container. In addition to the subjects' reading ratings, the amount of time subjects spent viewing the front, back, and top panels of the container was measured. The time measurements were taken from a counter that was superimposed on the video tapes of the experimental sessions. The precision of the counter was 60 Hz. However, the speed of the video recorder was only 30 Hz. Therefore, the precision of the time measurements was 30 Hz. The viewing times were extracted from the video tapes by a research assistant who was unaware of the research hypotheses.

Complete viewing time data were obtained for 57 of the 80 subjects. Complete data were obtained from at least 12 subjects in each experimental condition. Reasons for not obtaining complete viewing time data included: 1) subjects leaving the camera's field of view with the product in hand, 2) subjects turning their back to the camera with the product in hand, and 3) subjects holding the product while crouched behind the doors of the sink cabinet.

Table 3.10 shows the mean viewing times for each panel before dispensing the lye, after dispensing the lye, and the total viewing time. The viewing times shown in Table 3.10 were averaged across the four experimental conditions. This pooling of times across conditions was done after an analysis of variance for each panel of the container found that the viewing times did not vary significantly across the four conditions ($p > 0.10$). In fact, the time spent viewing all three panels combined did not differ significantly across the four experimental conditions ($p > 0.10$). The implication of these analyses of variance is that neither the presentation format nor the location of safety instructions significantly affected the amount of time subjects spent viewing the various panels of the label. This result is interesting in light of the fact that, as previously described, attention to and compliance with label warnings and instructions did vary significantly and substantially across experimental conditions.

Table 3.10

Mean viewing times for each panel before dispensing the lye, after dispensing the lye, and the total viewing time for each panel (N = 57).

Panel of Container	*Mean Viewing Time (seconds) (averaged across experimental conditions)* Before Dispensing Lye	After Dispensing Lye	Total (Before + After)
Front	1.99 (0.34)	0.86 (0.34)	2.85 (0.46)
Back	57.12 (5.74)	21.04 (3.61)	78.16 (5.89)
Top	14.24 (1.20)	0.79 (0.34)	15.03 (1.22)

Standard errors appear in parentheses.

An analysis of variance was conducted to determine the effect of label panel on the viewing time. The variability in total viewing times across label panels was found to be significant, $F(2, 168) = 134.5$, $p < 0.01$. In addition, all pairwise comparisons between the label panels were found to be significant using the Scheffe F-test ($p < 0.05$). More specifically, the total viewing time for the back panel was greater than the front panel by an average of 75 seconds, the total viewing time for the back panel was greater than the top panel by an average of 63 seconds, and the total viewing time for the top panel was greater than the front panel by an average of 12 seconds.

Relationship Between Reading and Complying with Instructions

One way to assess the effectiveness of a warning or instruction is to contrast how users would behave in the absence of or inattention to written instructions and warnings, and how they would behave given that they attended to the written information. Table 3.11 illustrates the percentage of subjects who complied with the eight safety and usage instructions given that they did/did not read a particular instruction. For seven of the eight

instructions, the rate of compliance for subjects who did read instructions was higher than for subjects who did not. In fact, averaging across the instructions, 84 percent of the subjects followed an instruction, given that they read it, versus 34 percent given that they did not read it.

Table 3.11

Percentage of subjects complying with safety and usage instructions given that they did/did not read the instruction.

Instruction	*Percentage of Subjects Complying With Instruction Given Subject:*	
	Read Instruction	*Did Not Read Instruction*
1. Use protective eyewear*	73%	3%
2. Wear rubber gloves*	86%	21%
3. Make sure water in drain is cool*	85%	14%
4. Add three level tablespoons of lye*	64%	43%
5. Immediately replace cap securely*	100%	84%
6. Use a plastic spoon**	95%	10%
7. Remove any standing water**	68%	9%
8. Remove drain sieve from sink**	100%	100%
Mean Compliance Rate	84%	36%

* Safety instruction

** Nonsafety instruction

Table 3.11 also illustrates that the variation in compliance rates across the instructions was greater for those subjects who did not read the instructions than for those

subjects who did. That is, compliance rates ranged from 3 percent to 100 percent for subjects who did not read the instructions, but only 64 percent to 100 percent for subjects who did read the instructions. The compliance rates in Table 3.11 indicate that behaviors such as removing the drain sieve and replacing the cap were likely to occur regardless of attention to the label, whereas behaviors consistent with instructions 1, 2, 3, 6, and 7 were much less likely to occur if the instructions were not read. In fact, Figure 3.13 shows that the percentage of subjects who replaced the cap and removed the drain sieve was actually higher than the percentage of subjects reading these instructions. These behaviors were apparently part of the scripts that most users had for using this type of product.

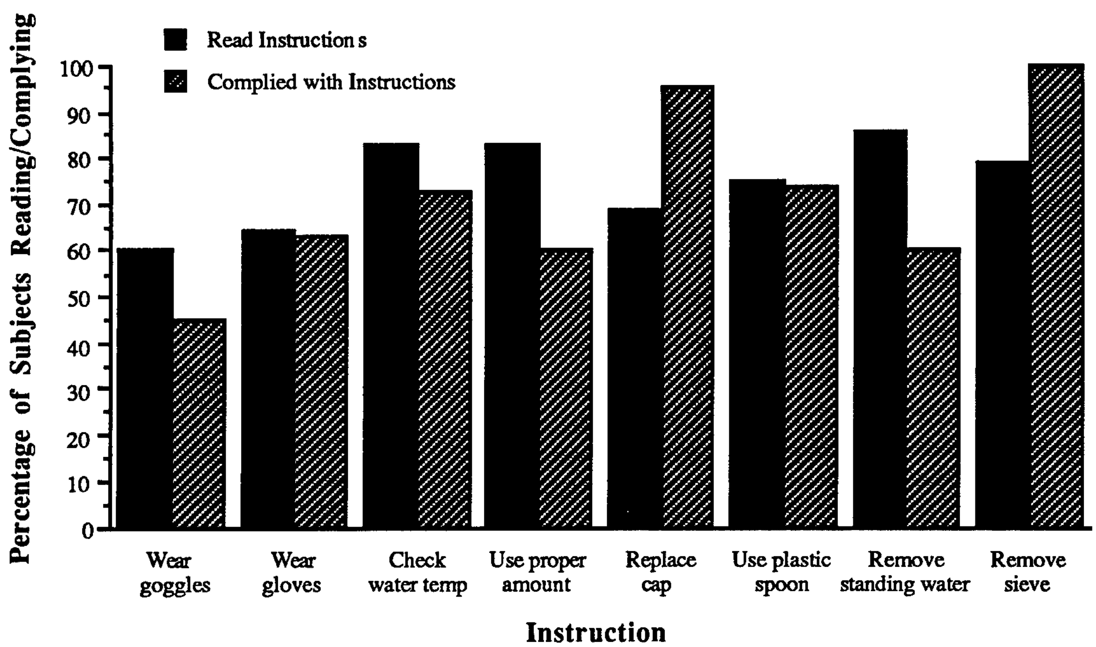

Figure 3.13 *Overall percentage of subjects who reported reading instructions and percentage of subjects who complied with each safety and usage instruction.*

Effect of Subject Characteristics on Attention to and Compliance with Instructions

In addition to the two presentation factors, the effect of several subject characteristics on the attention to and compliance with instructions was examined using the reading and compliance composite scores previously described. The subject characteristics evaluated were gender, age, and prior experience using liquid and crystal drain openers.

Gender. Since an equal proportion of males and females were assigned to each condition, the responses from all four conditions were pooled to analyze the effect of gender on the four composite scores: Safety Instruction Compliance Score, Safety and Usage Instruction Compliance Score, Safety Instruction Reading Score, Safety and Usage Instruction Reading Score. An analysis of variance found that gender did not significantly affect any of the reading or compliance scores ($p > 0.10$).

Age. With respect to age, an analysis of variance found that age did not differ significantly across the four experimental conditions and, as a result, subjects were pooled from all four conditions to analyze the effect of age. Regression analysis found that age was not significantly related to any of the reading or compliance scores ($p > 0.10$). This finding is not surprising considering the variability in subject age was quite small. The mean age was 20.7 with a standard deviation of 1.5.

Experience with drain openers. Regarding the effect of prior experience with drain openers, subject experience with drain openers was assessed by a series of questions asked during the latter part of the post-task interview. Specifically, subjects were asked: 1) How many times have you used a crystal drain opener before today? (never, once, a few times, or many times), 2) When was the last time you used a crystal drain opener? (within the last few days, weeks, months, years, never), 3) How many times have you purchased a crystal drain opener? (never, once, a few times, or many times), and 4) When was the last time you purchased a crystal drain opener? (within the last few days, weeks, months, years, never). Subjects were also queried as to the frequency and recency of *liquid* drain

opener use and purchase using the same series of questions. These four objective measures constitute a qualitatively different aspect of a subject's experience with crystal/liquid drain openers which, collectively, constitute the subject's experience (cf. Johnson, Lehmann, Fornell, and Horne, in press). In order to obtain a measure of the underlying, unobservable experience construct for liquid and crystal drain openers, the responses to each series of questions (liquid and crystal drain openers) were subjected to a principal components analysis. The basic objective of principal components analysis is to represent a set of observable variables in terms of a smaller set of unobservable or unmeasurable components or factors developed from a linear combination of the observed variables (Green, Tull, and Albaum, 1988). The results of the principal components analysis are shown in Tables 3.12 and 3.13. These tables illustrate that a single component accounted for 78% of the variance in scores for the crystal drain opener and 72% of the variance for the liquid drain opener. The loadings for Component 1 were combined with the standardized measures obtained from the subjects to produce an index of experience for crystal drain openers and for liquid drain openers. The resulting experience scores for each subject were used to determine the effect of experience on the reading and compliance composite scores.

As with age, an analysis of variance found that the liquid and crystal drain opener experience scores did not differ significantly across the four experimental conditions which allowed for pooling of scores across conditions. Each of the four composite reading/compliance scores was regressed on the each of the two experience scores. No significant relationships were found between any of the composite compliance scores ($p > 0.10$) or composite reading scores ($p > 0.05$). The correlation coefficients between each of these scores is shown in Table 3.14.

Considering previous consumer research demonstrating the effects of product familiarity on how consumers search for information (cf. Johnson and Russo, 1984), the interaction between experience with liquid/crystal drain openers and label condition was

also assessed. Subjects were placed into one of two experience categories, those with no experience using or purchasing liquid/crystal drain openers and those with at least some experience. The interaction between label condition and level of experience was not significant ($p > 0.10$).

In light of previous research showing a significant negative relationship between experience or familiarity with a product and the reported propensity to read instructions (see Dejoy, 1989), it is important to note that, by design, the degree of experience with the drain opener did not vary a great deal across subjects. Figures 3.14 and 3.15 illustrate that the majority of subjects had little experience purchasing and using drain opener products. This result is expected since one objective in selecting an experimental product, task, and subject was to create a situation in which users would have difficulty relying solely on their previous experiences and would likely seek some form of external information. The implication of this limited range of subject experience is that it is possible that, given a broader range of subject experience, a relationship might exist between experience and attention to and compliance with instructions.

Table 3.12

Component loadings for measures of experience with crystal drain openers.

Measured Experience Variable	*Component*			
	1	*2*	*3*	*4*
Number of times used drain opener	0.884	-0.405	0.203	-0.112
Last time used drain opener	0.912	-0.353	-0.163	0.132
Number of times purchased drain opener	0.847	0.451	0.274	0.068
Last time purchased drain opener	0.891	0.335	-0.295	-0.088
Percent of Total Variance Explained by Components	78.10%	15.11%	5.75%	1.05%

Table 3.13

Component loadings for measures of experience with liquid drain openers.

Measured Experience Variable	*Component* 1	2	3	4
Number of times used drain opener	0.871	-0.384	0.201	-0.229
Last time used drain opener	0.846	-0.452	-0.178	0.220
Number of times purchased drain opener	0.840	0.439	0.278	0.155
Last time purchased drain opener	0.848	0.412	-0.305	-0.138
Percent of Total Variance Explained by Components	72.48%	17.85%	6.06%	3.61%

Table 3.14

Correlation matrix for experience scores and reading and compliance composite scores.

Composite Reading/Compliance Score	Experience Score: *Crystal Drain Opener*	*Liquid Drain Opener*
Safety Instruction Compliance Score	0.008	0.087
Safety and Usage Instruction Compliance Score	0.001	0.141
Safety Instruction Reading Score	0.150	0.188
Safety and Usage Instruction Reading Score	0.108	0.197

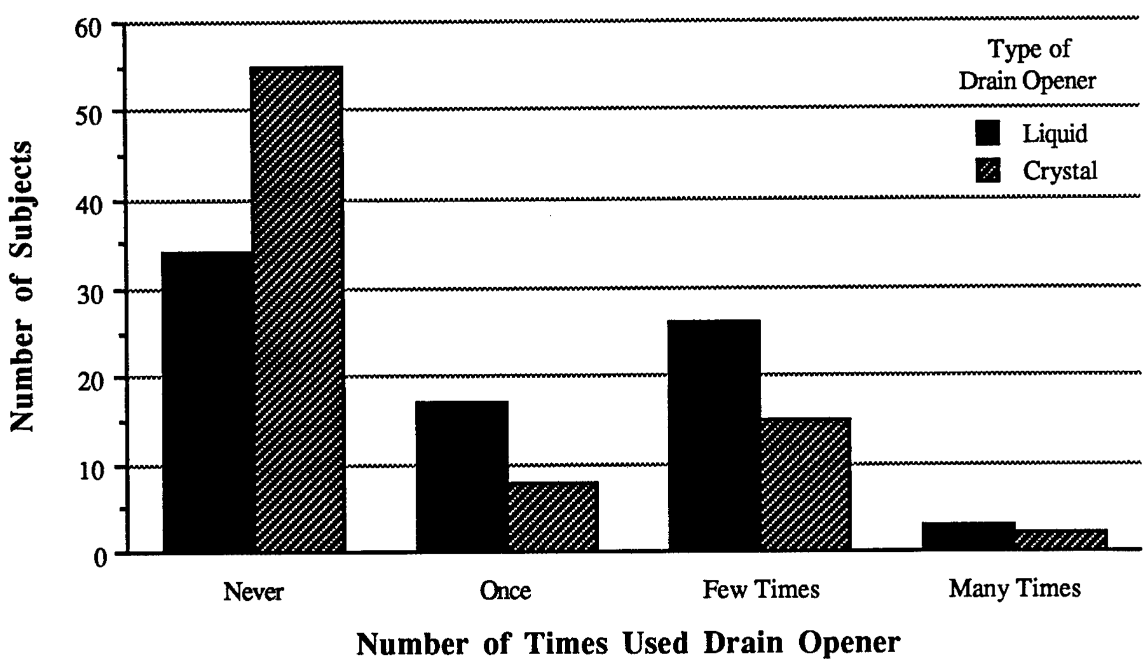

Figure 3.14 *Distribution of responses to the question, "How many times have you used a crystal/liquid drain opener?" (N = 80)*

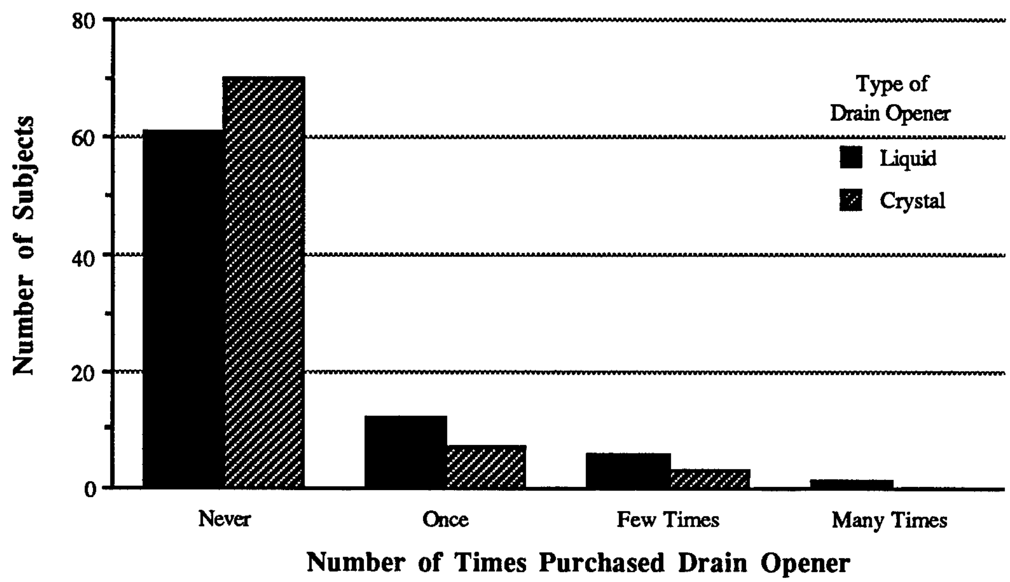

Figure 3.15 *Distribution of responses to the question, "How many times have you purchased a crystal/liquid drain opener?" (N = 80)*

Perceived Hazardousness

During the post-task interview subjects were asked, "In your opinion, how hazardous is the drain opener to use?" They were provided with a seven-point, bipolar scale ranging from not very hazardous to very hazardous. Note that the response to this question provides a measure of perceived hazardousness after using the product as opposed to before using the product. If subjects expressed any uncertainty regarding the timing of their opinion, they were instructed to express their opinion of the product after having used it as opposed to attempting to recall their initial perceptions prior to using the product. Thus, for purposes of this experiment, the rating of hazardousness is considered a

dependent measure rather than an independent measure that could be causally linked to the attention to and compliance with the instructions and warnings.

The primary reason for measuring subject perceptions of product hazards was to determine how changes in the presentation of product information might effect the users' overall assessment of product hazardousness. The mean hazardousness ratings for each level of the two presentation factors are shown in Figure 3.16.

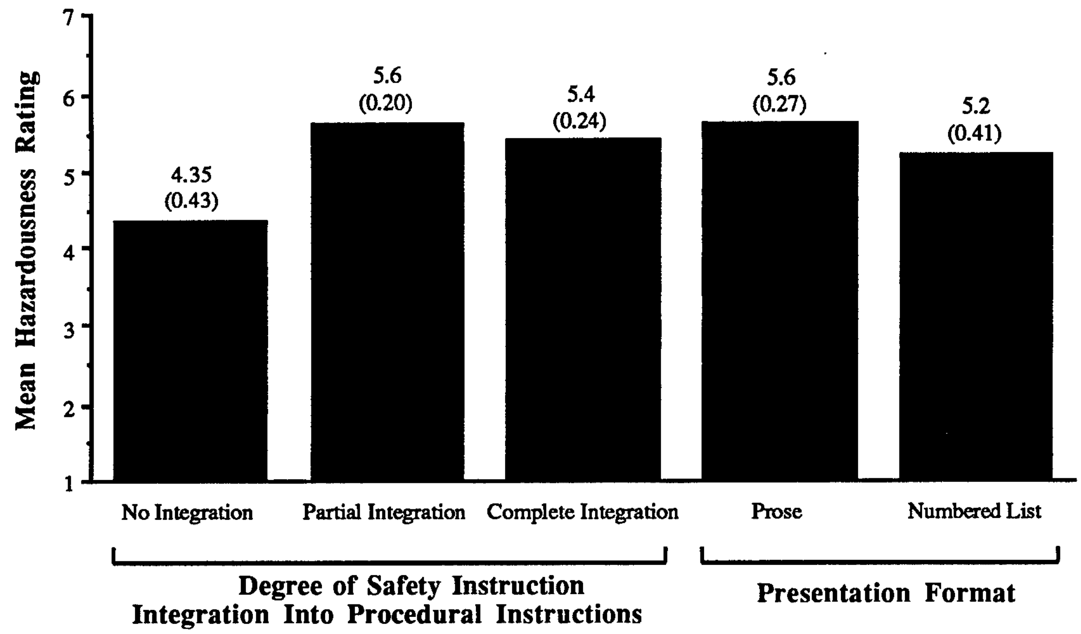

Figure 3.16 *Mean hazardousness ratings for each level of the two presentation factors (standard errors appear in parentheses).*

The effect of presentation format on the rating of product hazardousness was not significant ($p > 0.10$). However, the effect of safety instruction integration into usage instructions was significant, $F(2,77) = 4.19$, $p < 0.05$. Pairwise comparisons between the three levels of integration using the Scheffe F-test found that the hazardousness ratings were significantly higher when the warnings and instructions were partially and completely

integrated than when they were totally separated ($p < 0.05$ for both comparisons). The ratings for the partial and complete levels of integration did not differ significantly ($p > 0.10$). Thus, the drain opener label with the largest precaution section and the smallest directions for use section (Condition 2) resulted in hazardousness ratings that were *less* than those for labels displaying a smaller precautions section and larger directions for use section (Conditions 1, 3, and 4). Although, intuitively, one would expect that the perceived hazardousness would increase with the size of the precautions sections, the opposite was found to be true.

Significant positive correlations were found between ratings of product hazardousness and the Safety Instruction Compliance Score ($r = 0.38$, $p < 0.01$), the Safety and Usage Instruction Compliance Score ($r = 0.46$, $p < 0.01$), the Safety Instruction Reading Score ($r = 0.52$, $p < 0.01$), and the Safety and Usage Instruction Reading Score ($r = 0.48$, $p < 0.01$). Thus, the more instructions and warnings subjects read/complied with, the greater the perceived hazardousness associated with using the product. In addition, a significant positive correlation was found between rating of product hazardousness and amount of time spent viewing the back panel of the container ($r = 0.43$, $p < 0.01$). However, the hazardousness ratings were not significantly correlated with the amount of time spent viewing the front panel ($r = 0.04$, $p > 0.1$) or the top panel ($r = 0.23$, $p > 0.05$).

With regard to the relationship between subject characteristics and perceived hazardousness, reliable correlations were not found between hazardousness ratings and gender ($r = 0.18$, $p > 0.1$), age ($r = 0.05$, $p > 0.1$), experience index for liquid drain openers ($r = 0.17$, $p > 0.1$), or experience index for crystal drain openers ($r = 0.02$, $p > 0.1$).

In summary, the only independent variable significantly correlated with the perceived hazardousness was the level of safety instruction integration into usage instructions. No other label or subject attribute was reliably related to the rating of product hazardousness.

Reasons for Not Complying with Instructions

During the post-task interview, subjects who read but did not comply with an instruction were asked their reasons for noncompliance. The reasons for knowingly not complying with instructions can be separated into two categories: 1) forgetting to comply and 2) deciding not to comply. In the vast majority of cases, subjects decided not to comply as opposed to forgot to comply. More specifically, across all instructions, there were 47 occurrences of subjects deciding not to comply with an instruction versus 4 occurrences of subjects reading an instruction and forgetting to comply.

It is important to note that the reasons provided by subjects for not complying with instructions are susceptible to a number of pitfalls. For example, subjects may provide a logical rationale for behaving in a certain manner despite having an actual recollection as to why they did or did not do something. Second, questioning subjects regarding the rationale for their behavior can be hampered by the social desirability phenomenon whereby people tend to report more socially desirable bases for there behavior, rather than report their actual rationale.

<u>Deciding not to comply with instructions</u>. The reasons for deciding not to comply with an instruction varied across different instructions. For the instruction to wear protective eyewear, 5 of the 11 subjects who read the instruction but decided not to comply indicated that as long as they were careful they could keep the drain opener out of their eyes. One of these five subjects stated that he thought he could be careful enough to keep the drain opener out of his eyes but not off of his hands. Perhaps this is one reason why more subjects wore gloves than goggles. Three subjects didn't think that the drain opener would get in their eyes and one of those three mentioned that the goggles would be bothersome to wear. One subject responded that he couldn't see how the drain opener could get in his eye, indicating a lack of understanding of how the hazard to one's eyesight

might manifest itself. Another pair of subjects didn't wear the goggles because they didn't consider the product to be dangerous to their eyesight.

With respect to the instruction to wear rubber gloves, seven subjects decided not to wear rubber gloves after reading the instruction. Four subjects indicated that they didn't think the drain opener would get on their hands; two of the four cited the use of a spoon as a means of keeping it from their hands and one of the four stated, "A minimally competent person wouldn't get it on themselves." Two subjects felt that the drain opener didn't seem dangerous enough to wear rubber gloves and another said that it just didn't seem necessary to wear them. Again, these responses indicate a lack of understanding of the nature of the hazard, specifically the splattering and splashback potential of the drain opener after it is dispensed.

For the instruction to use a plastic spoon to dispense the lye, three subjects decided not to comply. One subject felt it is easier to pour the lye directly into the sink, another responded that he was familiar with the amount to dispense so he just poured it in the sink, and the third subject thought that it wouldn't make any difference whether she used a spoon or poured it directly in the sink.

With respect to making sure that the water in the sink was cool before dispensing the drain opener, seven subjects who read the instruction decided not to comply. Six of the seven didn't check the temperature of the water because they assumed that it was cool already and the seventh subject thought that the water was dirty and didn't want to touch it.

Finally, 19 subjects who read the instruction to remove the standing water from the sink decided not to. Of those 19, ten reported that they weren't sure how to remove the water, seven didn't perceive a need to remove the water (i.e., they felt they could still unclog the drain with the water in the sink), one subject had apparently put some drain opener in the sink before reading the instruction and didn't want to touch the solution of water and lye, and, interestingly, the other subject stated that since the water in the sink was cool there was no need to remove it.

It is important to note that it was only for the instructions to wear gloves and goggles that subjects' decisions not to comply involved some consideration of the risks associated with noncompliance. For the other instructions, subjects' decision processes apparently did not include a consideration of the risk of injury associated with not complying with the instructions. This suggests that subjects perceived these instructions as pertaining to the effective use of the product rather than the safe use of the product. As a result, they were not considering the safety implications of their decision not to comply with the instructions.

Forgetting to comply with instructions. Across 7 of the 8 instructions in Table 3.2 and all 80 subjects, a total of 412 instructions were read. For those 412 instructions read, only 4 times did subjects not comply because they forgot. One subject forgot to wear the goggles. One subject put the rubber gloves on then took them off in order to remove the cap and forgot to put them back on. One subject forgot to check the temperature of the water in the sink and one subject inadvertently used a metal spoon instead of a plastic spoon.

To determine the effect of instruction location on the rate of inadvertent noncompliance, the overall rate of subjects forgetting to comply was computed for instructions that appeared in the precautions section and for instructions that appeared in the directions for use section. For instructions that appeared in the directions for use, the rate of inadvertent noncompliance was 0.27% (1 out of 362), and for instructions that appeared in the precautions section the rate of inadvertent noncompliance was 6.0% (3 out of 50). The difference between these rates was found to be significant using the normal approximation to the binomial distribution ($p < 0.001$). Thus, subjects were more likely to read an instruction and forget to comply with it when the instruction appeared in the precautions section rather than the directions for use.

It should be noted that forgetting to comply with an instruction represents a type of error commonly categorized as a "slip," which refers to departure of action from intention

or, in this case, failure to execute an intended action (Reason, 1987). Thus, this experiment found that the likelihood of a slip was greater if an instruction was located in the precautions section rather than the directions for use. This type of error is distinct from those associated with deciding not to comply with instructions which typically involves an error in judgment or reasoning. Clearly, with respect to this experiment, noncompliance with instructions that subjects had read was primarily a result of judgment-based and knowledge-based processing rather than failing to execute intended actions.

Motivation for Reading Top of Container

During the pilot study several subjects attempted to remove the plastic cap, were unsuccessful, then read the information on the top panel surrounding the cap and proceeded to remove it. This observation was particularly interesting in light of recent research involving the effect of task interference on the attention to and compliance with product warnings (Frantz and Rhoades, in press). To examine how difficulty removing the plastic cap might motivate subjects to read the top panel, subjects were asked whether they read the information on the top of the container before or after attempting to remove the cap. Of the 75 subjects who reported to have read at least some of the information on the top of the container, 46 indicated that they read it after attempting to remove the cap and 26 read it before attempting to remove the cap. Thus, more than half of the subjects unsuccessfully attempted to remove the cap before deciding to read the information surrounding the cap. Interestingly, a t-test found that the amount of time subjects spent viewing the top panel did not differ significantly between subjects reading the top before and subjects reading the top after attempting to remove the cap ($p > 0.10$).

Summary of Key Results

Due to the large of amount of data and results previously presented, a list of key results was compiled in an effort to efficiently summarize the findings. The key results from the first experiment are as follows:

Location of warnings relative to usage instructions.

- Moving safety instructions from the precautions section into the directions for use significantly increased compliance.

- On average, moving an instruction (safety or otherwise) from the precautions into the directions for use increased the compliance rate from 48% to 82%.

- Labels in which the safety instructions were completely integrated into the directions for use produced significantly higher rates of compliance than those that presented some or all of the safety instructions separate from the directions for use (as per current practice).

- Moving safety instructions from the precautions section into the directions for use significantly increased the proportion of subjects who reported reading the safety instructions.

- On average, moving an instruction (safety or otherwise) from the precautions into the directions for use increased the proportion of subjects reading an instruction from 37% to 89%.

- Labels in which the safety instructions were completely integrated into the directions for use produced significantly higher reading rates than those that presented some or all of the safety instructions separate from the directions for use (as per current practice).

- For three warning messages unrelated to the experimental task, moving the warnings from the precautions into the directions for use increased the average proportion of subjects who correctly recognized the hazard avoidance procedure from 13% to 59%.

Relationship between reading and complying with instructions.

- Averaging across the safety and nonsafety instructions, 84% of the subjects followed an instruction, given that they read it, versus 34% given that they did not read it.

Prose versus numbered list format.

- Presenting the directions for use in a numbered list format versus a prose format did not significantly affect overall label effectiveness.

User processing of product information.

- Regarding strategies subjects used in deciding what information to read on the back of the label, eighty-five percent (85%) of the subjects indicated that they were searching primarily for information on how to use the product.

- Sixty-three percent (63%) of the subjects reported that they read the majority of the information on the back of the label first and then went back and read a sentence or two and performed an action.

- The presentation format of the directions for use did not affect the way subjects used the information on the back of the drain opener label.

- The label condition did not affect the reading ratings (i.e., proportion of label/panel read) for any of the label panels or sections of the back panel.

- The reported proportion of information read was highest for the directions for use section, followed by the precautions sections, then the first aid section, and finally the storage and disposal section.

- On average, subjects reported that they read "almost all" of the information in the directions for use versus only "some" of the information in the precautions section.

- The label condition did not affect the amount of time subjects spent viewing the panels of the container.

Effect of subject characteristics.

- Subject gender did not significantly affect the composite reading or compliance scores.

- Subject age did not significantly affect the composite reading or compliance scores.

- Subject experience with liquid or crystal drain openers did not significantly affect the composite reading or compliance scores.

Product hazardousness.

- Subject rating of product hazardousness was positively correlated with the level of safety instruction integration into usage instructions -- no other label or subject attribute was reliably related to the rating of product hazardousness.

Reasons for not complying with instructions.

- The vast majority of times that subjects did not comply with an instruction they reportedly decided not to comply versus forgot to comply.

- Subjects were more likely to read an instruction and forget to comply with it when the instruction appeared in the precautions section rather than the directions for use.

Discussion

Summary of Presentation Factor Effects

As hypothesized, providing a complete procedure for the safe and effective use of the drain opener dramatically increased the proportion of subjects who read and complied with the safety and usage instructions. The increased attention to messages included in the directions for use even extended to warnings that were not specific to the experimental task. In addition, the rate of subjects inadvertently failing to comply with safety instructions was lower when the messages appeared in the directions for use rather than in the precautions section. Interestingly, these benefits were achieved without significantly increasing the amount of time subjects spent viewing the panels of the label.

On the other hand, presenting the usage instructions in a numbered list rather than in a prose format reliably increased the compliance rate only for the instruction to wear rubber gloves. It did not do so for any of the other safety or usage instructions examined in this experiment. This unexpected result may be explained in two ways. First, recall that the hypothesis that a numbered list format would be more effective than a prose format was based on the presumption that a numbered list format would provide for more efficient re-entry into the text as users performed the task. Implicit in this reasoning is the assumption that users would tend to use the information differently depending on the presentation format. Namely, it was initially assumed that if the directions were presented in a numbered list format, users would be more inclined to read an individual step and perform an action than to read the entire set of directions. This, however, was not the case. Instead, the different presentation formats did not affect how subjects used the information on the back of the label. The second point that helps explain the lack of an expected effect is the fact that more than half of the subjects in both format conditions reported that they read the majority of the directions first then went back and read a sentence or two and

performed an action. The prevalence of this strategy was somewhat surprising and may have served to reduce the errors of omission that might occur more frequently when users do not first read the directions to gain a general idea of the entire procedure before executing the individual steps. In summary, the similarity between the two presentation formats can reasonably be linked to the finding that subjects reported using the same basic processing strategy in both formats, and that the majority of subjects reported reading the label in a manner that would tend to reduce errors of omission due to repeated re-entry into the text.

A final note regarding the effect of presentation format is that the procedure for using the product was relatively short and fairly consistent with generic "dispensing" scripts that users are likely to have. As a result, the generalizability of these results to more lengthy and unpredictable sets of instructions is unknown. Clearly, integrating the safety instructions into the directions for use had a much greater effect on user behavior than changing the directions for use from a prose to a numbered list format.

User Processing of Product Information

This experiment produced a number of insights into how people use and process product information during product use. First, the finding that subjects read only portions of certain sections of the label (e.g., precautions section) provides evidence that users may selectively attend to label information rather than thoroughly read each and every section in its entirety. Second, based on the post-task interviews, this sampling or scanning behavior was typically guided by the user's search for instructions to perform the required task rather than a desire to obtain general product information that is not directly related to task performance (i.e., generic precautions, first aid, and storage and disposal information). This finding is consistent with research conducted by Venema (1989) in which subjects

used consumer products under highly realistic simulated usage conditions similar to the present experiment. Venema reported the following (as translated from Dutch):

> There were 286 reasons why the label had been read. It was usually indicated here what information was sought. The directions for use were mentioned 107 times. Hazard and safety information was looked for in 53 cases, and the label was said to have been read in 29 cases because a specific hazard was expected.

With regard to the truncated processing of the precautions section, the results from this experiment are consistent with the previously mentioned studies by Friedmann (1988) and Strawbridge (1986) in which a substantial proportion of subjects read only the initial portion of product warning statements and then moved on. Not only did this experiment yield results that were consistent with this previous research, it also revealed an additional motive for partial processing of different sections of the label. Namely, several subjects mentioned that the general information at the beginning of the precautions section was consistent with their expectation or knowledge of the product (i.e., the drain opener is poisonous, should not be ingested, should be kept out of eyes, etc.). As a result, further processing of the precaution section was deemed unnecessary because the text in that section was not expected to provide any new information. Unfortunately, subject recognition of these general product hazards was not sufficient to prompt important safety precautions (e.g. wear gloves and goggles).

Third, the fact that subjects selectively filtered out and attended to certain portions of the label illustrates the complexity of the cognitive processing associated with reading product labels. That is, in addition to text comprehension, subjects are making a variety of judgments and predictions about the upcoming text, such as the likelihood that it will provide information that is not already known and the likelihood that it will provide information pertinent to task accomplishment. These extra cognitive activities serve to differentiate the "reading" of product warnings and instructions from other reading tasks that do not require or prompt additional and perhaps simultaneous cognitive processes.

Fourth, the fact that 46 out of 75 subjects read the instructions on the top of the can after unsuccessfully attempting to remove the cap provides an example of users' tendency to rely on prior knowledge to achieve their goals rather than initially seeking and processing written product information. Specifically, the features of the drain opener cap apparently provided enough cues to the majority of users to prompt them to attempt to remove the cap without attending to the directions encircling the cap. In addition, this finding illustrates that product features which interfere with users' intended actions can prompt users to attend to written information in the vicinity of the interference. This interference effect was also found and more thoroughly discussed by Frantz and Rhoades (in press) in a study involving the proper loading of a two-drawer file cabinet.

A fifth finding regarding the use and processing of product information is that the ratings of product hazardousness were apparently affected by text-level processing of information, more so than pre-text or aesthetic processing of the information. That is, the rating of perceived hazardousness was positively correlated with the degree of safety instruction integration into the directions for use, rather than the size of the precautions section. Thus, in this case, the larger the precautions sections the *less* hazardous the product was perceived to be. If subjects were basing their perception of product hazardousness on the size of the precautions section, one would expect the opposite relationship to be true. Instead, the perception of product hazardousness was related to the amount of information read in the directions for use.

Integrating Warnings Into Flow of Task Information Versus Increasing Stimulus Intensity

According to Lehto and Miller (1986) a research topic of pressing interest is the relative importance of integrating a warning message into the flow of task-related information as opposed to increasing the intensity or conspicuity of the warning. The present experiment begins to shed light on this important topic. First, the results of this

experiment suggest that the usage instructions were typically part of the task-related information that subjects processed in order to perform the task. Second, when the safety-critical messages were included in this task-related information, the proportion of subjects attending to the messages increased. This increased attention was not the result of an increase in the conspicuity or physical salience of the warning message. On the contrary, the safety instructions that appeared in the directions for use were not highlighted in any way. In fact, outside the context of product use, the safety instructions appearing in the precautions would be considered more prominent due to larger type size, bold print, capital lettering, and a red border surrounding the precautions sections. Thus, decreasing the apparent conspicuity of the safety instructions, by moving them from the precautions to the directions for use, actually increased the attention to and compliance with the instructions because subjects were generally searching for task-related information within the usage instructions. This illustrates the importance of integrating warning information into the flow of task information, relative to exclusively considering the stimulus intensity of the warning in relation to other label components.

In a more general sense, the results of this experiment suggest that a warning judged to be highly conspicuous outside the context of task performance may, in fact, be less likely to be processed than an apparently inconspicuous warning that is a subset of the task-related information. Once again, the implication is that the nature of the interaction between the user, product, and product information is an important consideration during the design and evaluation of product warnings and instructions, and that "common sense" approaches to design and evaluation can be greatly flawed.

Implication of Results to a Common Assertion About Warnings

It is a common assertion that product warning labels can effectively lower product liability but are generally incapable of changing behavior (cf. Moore, 1991). This assertion

suggests that the role of warnings is one of loss control rather than accident prevention. Indeed, this experiment suggests that these objectives can be distinct and, in some cases, in conflict with one another. Conditions 1 and 2, in which some or all of the safety instructions were presented in the precautions sections rather than the directions for use, are more likely to combat failure-to-warn allegations than the other two labels. This is because of the face validity associated with including the various safety instructions in a precautions section and not "burying" them in the directions for use. In contrast, Conditions 3 and 4, in which the safety instructions were included in the directions for use, were substantially more behaviorally effective than the other two labels but they would likely be less "defensible" in a products liability setting. Thus, the labels that are more likely to prevent accidents are less likely to help control losses from litigation arising from accidents. The apparent conflict between preventing accidents and reducing liability stems from the common but empirically unfounded practice of segregating safety instructions from usage instructions.

CHAPTER IV

EXPERIMENT 2: EFFECT OF LOCATION AND PROCEDURAL EXPLICITNESS ON ATTENTION TO AND COMPLIANCE WITH PRODUCT WARNINGS

Introduction

The primary objective of this experiment was to determine the effect of two presentation factors on the attention to and compliance with product warnings and instructions. The presentation factors under investigation were: 1) the location of safety instructions (precautions) relative to usage instructions, and 2) the procedural explicitness of precautions. Additional objectives of the experiment were to examine and document user processing of product information during task performance and to assess the benefits of a user-oriented approach to warning design.

As in the first experiment, a primary hypothesis was that providing a complete procedure for using a product (including providing precautionary measures) in a central location will increase the likelihood that the product is used in a safe manner. More specifically, integrating safety instructions into the directions for using a product will increase the likelihood that the precautions are noticed, read, and complied with, more so than providing the safety instructions in a separate section apart from the directions for use. Though both experiments were designed to test this same hypothesis, this experiment differed from the first experiment in that a different experimental product was used and the separation between warnings and directions was greater than with the drain opener label.

Thus, the second experiment was designed to test the robustness of the findings from the first experiment. This was considered an important feature of the dissertation research in light of the importance of the "location" issue and the common criticism that warnings research may not be generalized to other products or settings.

Method

Description of Experimental Product

The experimental product was a water repellent sealer (see Figure 4.1). As with the drain opener, the water sealer product was desirable because its hazardous contents could be altered without the subject's knowledge and because it was likely to be unfamiliar to most of the subjects. In addition, the fictitious water sealer was designed to be representative of those household products whose vapor flammability and/or toxicity present serious risks of fire and health hazards. Vapor flammability has been particularly problematic with numerous flash fires due to ignition by such sources as pilot lights, light switches, cigarettes, and portable space heaters (see Nelson, 1976). Though water sealer products are generally not as volatile as other household products such as paint strippers, furniture refinishers, and various solvent-based adhesives, the experimental product's label was designed as if its vapors presented a serious risk of flash fire.

The primary hazards associated with using this fictitious water sealer were flash fire from ignition of flammable vapors, inhalation of vapors, and contact with eyes and skin. As such, important precautions included extinguishing all sources of ignition in the work area, venting fumes to the outdoors, and wearing eye and hand protection.

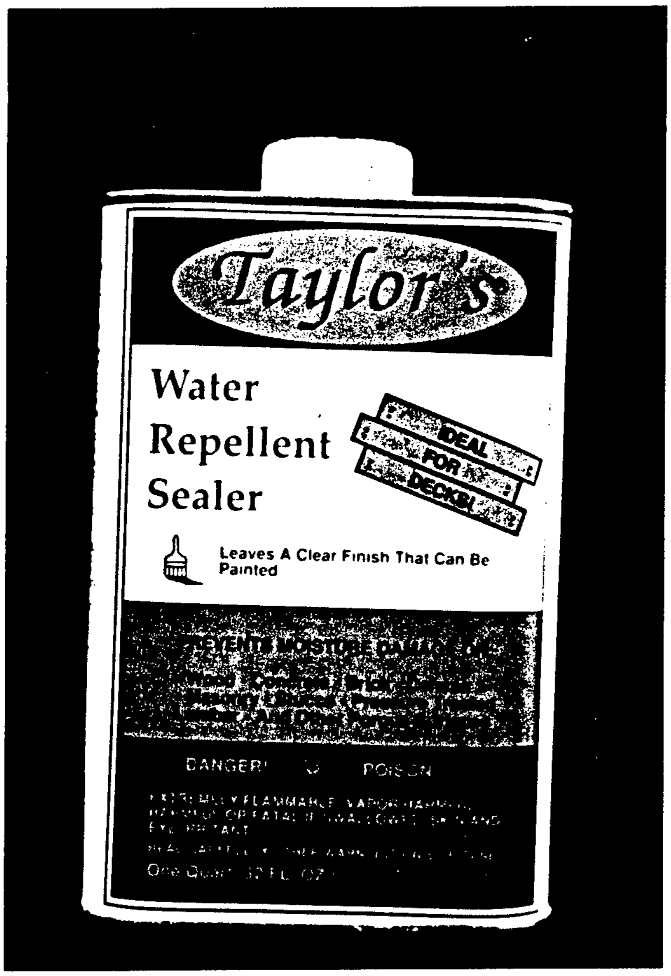

Figure 4.1 *Fictitious water repellent sealer.*

Description of Experimental Conditions

Condition 1: Procedurally nonexplicit precautions/precautions separate from usage instructions. Similar to the drain opener label in the first experiment, a Multi-Attribute Analysis was performed on a water sealer label that had been fashioned after a currently available product. This exemplar current label is shown in Figure 4.2 and the accompanying Multi-Attribute Analysis is shown in Table 4.1.

The label in this condition is characterized by: 1) warnings and precautions on the side panel separated from the directions for use which appear on the back panel, and 2) precautions that are presented in a procedurally nonexplicit manner (e.g., KEEP AWAY FROM OPEN FLAME OR SPARK, USE IN A WELL VENTILATED AREA, and AVOID CONTACT WITH EYES AND SKIN).

Regarding the location of the precautions, it is a common practice to place safety related information on the side panel(s) of rectangular containers. Thus, the placement of precautions on the side panel of the container is quite representative of the current state of product information.

While this experimental label is considered to be an example of the state-of-the-art labeling, one feature that is somewhat uncommon is the hazard descriptions that follow each precaution. These statements include: "Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire", "Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate", and "This product can cause blindness and severe burns to skin." These statements provide explicit information about the nature of the hazards and consequences of not taking actions to avoid the hazard. Thus, the warnings on this product can be thought of as being nonexplicit from a procedural standpoint but explicit from a motivational or hazard communication standpoint. That is, the nature of the hazards are explicitly stated but the context-specific procedures for avoiding the hazards are not

explicitly stated. This explicit hazard information was included so that all of the experimental conditions (both procedurally explicit and procedurally nonexplicit) provided the same level of motivation to comply with the precautionary measures provided. Without this explanatory information there was a concern that increasing the procedural explicitness of the precautions might also increase the perceived hazardousness of the product, and thus introduce a confound between the effect of procedural explicitness and the effect of perceived consequences associated with not complying with the precautions.

Taylor's® Water Repellent Sealer

WHAT IS TAYLOR'S WATER REPELLENT SEALER?
Taylor's is an all purpose, transparent waterproofer that penetrates dry porous materials to seal out water. This establishes a moisture barrier, yet allows the surface to breathe. Taylor's Water Repellent Sealer helps prevent damage for years, even under heavy moisture conditions. Taylor's dries clear so it never changes colour of the treated surface.

TAYLOR'S BENEFITS
WOOD: Ideal for protecting all types of wood, especially **pressure treated** wood. Reduces splitting, grain raising, and deterioration from wetting and drying.
CONCRETE: Waterproofs and seals to reduce spalling (from freeze-thaw) and efflorescence. Protects from de-icing salts and chemicals.
MASONRY/BRICK: Waterproofs dense concrete block, brick and stone and helps prevent spalling and efflorescence.
CANVAS, FABRIC: Waterproofs natural fabric, canvas, tents, tarpaulins, shoes, back-packs, sleeping bags, ground cloths, etc. May slightly darken certain fabrics - try an inconspicuous test patch first.
NOT TO BE USED ON ASPHALT, SYNTHETIC FIBRES, PLASTIC OR NATURAL RUBBER.

DIRECTIONS FOR USE
Surface and substrate must be thoroughly dry. This is very important since Taylor's will not fully penetrate wet or damp surfaces. Surface should be clean and free from all other coatings. We recommend a trial patch before you start.

APPLICATION:
1. For application, both surface and air temperature should be above 40° F.
2. Apply by brush, roller, dipping, or flooding spray.
3. On vertical surfaces, saturate well, apply from bottom up.
4. On horizontal surfaces, saturate well. After 15 minutes, remove puddles by redistributing to dry areas or wiping up.
5. For maximum protection, two coats are recommended.
6. To avoid lingering odors in confined areas such as basements, ensure that you have adequate ventilation.
7. Not intended for below grade application where water pressure is a problem.

DRYING TIME: Will vary depending on the surface and humidity. Allow at least 24 to 48 hours. Let dry at least 24 hours before applying a second application. Allow a minimum of 3 days before painting over Taylor's with oil based paint; 30 days when using top-quality latex paint.

ADDING TO OIL BASE PAINT OR STAIN: Add Taylor's full strength. Add at least 250 mL (1/2 pint) per 4 litres (gallon) to oil base paint or stain.

CLEAN UP: Clean brushes and equipment with paint thinner or mineral spirits.

Distributed by Sealant Products, Urbana, OH 43078

Taylor's®
Water Repellent Sealer

KEEP AWAY FROM OPEN FLAME OR SPARK, including all furnace or stove pilot lights, heaters, candles, and cigarettes – Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire. USE IN A WELL VENTILATED AREA – Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate. AVOID CONTACT WITH EYES AND SKIN – This product can cause blindness and severe burns to skin. KEEP OUT OF REACH OF CHILDREN.

PROTECT FROM FREEZING.

FIRST AID TREATMENT: CONTAINS VOLATILE MINERAL SPIRITS. IF SWALLOWED DO NOT INDUCE VOMITING. EYE CONTACT: FLUSH WITH WATER FOR 15 MINUTES. SKIN CONTACT: WASH IMMEDIATELY WITH SOAP & WATER. CALL PHYSICIAN IMMEDIATELY.

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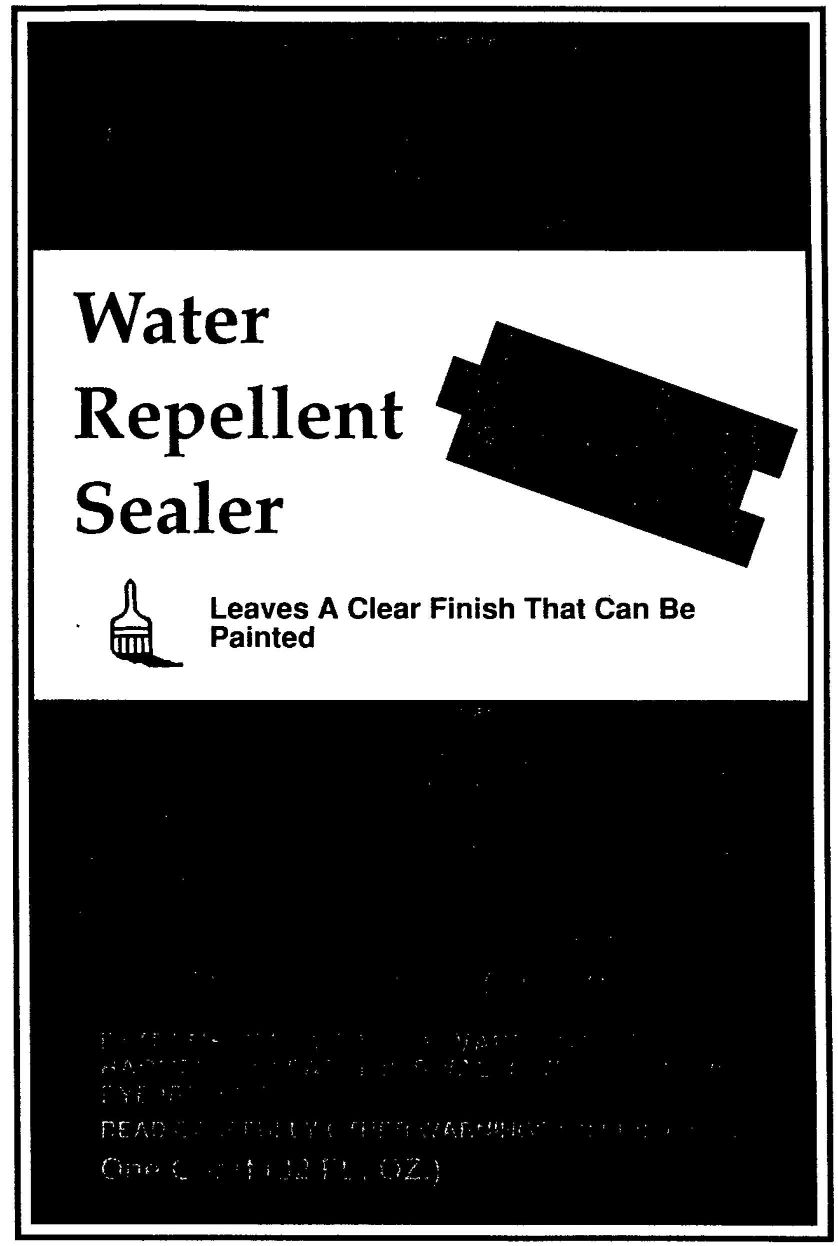

Figure 4.2 *Condition 1: Exemplar Current Water Sealer Label -- Procedurally Nonexplicit Precautions/Precautions Separate from Usage Instructions.*

Table 4.1

Multi-Attribute Analysis of Water Sealer Product Usage Information

Label Statement	Location of Statement (Side/Back panel)	Type of Message	Procedural Explicitness of Message	Temporal Relevance (Before, during, after use)	Element of Basic Level Procedure?	In Chronological Order?
Keep away from open flame or spark, including all furnace or stove pilot lights, heaters, candles, and cigarettes.	Side	Safety Instruction (precaution)	Non-Explicit	During and after use	Yes	Yes (only if side panel read before back)
Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire.	Side	Warning	Non-Explicit	During and after use	No	Yes (only if side panel read before back)
Use in a well ventilated area.	Side	Safety Instruction (precaution)	Non-Explicit	During and after use	Yes	Yes (only if side panel read before back)
Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate.	Side	Warning	Non-Explicit	During and after use	No	Yes (only if side panel read before back)
Avoid contact with eyes and skin.	Side	Safety Instruction (precaution)	Non-Explicit	Before, during, after use (primarily during use)	Yes	Yes (only if side panel read before back)
This product can cause blindness and severe burns to skin.	Side	Warning	Non-Explicit	Before, during, after use (primarily during use)	No	Yes (only if side panel read before back)
Keep out of reach of children.	Side	Safety Instruction (precaution)	Non-Explicit	Before, during, after use	No	Yes
Protect from freezing.	Side	Instruction (with safety element) (product/property protection)	Non-Explicit	Before and after use	No	Yes
First Aid Treatment: Contains volatile mineral spirits.	Side	Warning (to limited audience)	Non-Explicit	Before, during, after use	No	Yes
If swallowed do not induce vomiting.	Side	Contingency safety instruction (error recovery proscription)	Explicit	Before, during, after use	No	Yes
Eye contact: Flush with water for 15 minutes.	Side	Contingency safety instruction (error recovery prescription)	Explicit	Before, during, after use	No	Yes
Skin contact: Wash immediately with soap & water. Call physician immediately.	Side	Contingency safety instruction (error recovery prescription)	Explicit	Before, during, after use	No	Yes

Multi-Attribute Analysis of Water Sealer Product Usage Information (continued)

Label Statement	Location of Statement (Side/Back panel)	Type of Message	Procedural Explicitness of Message	Temporal Relevance (Before, during, after use)	Element of Basic Level Procedure?	In Chronological Order?
Directions for Use Surface and substrate must be thoroughly dry. This is very important since Taylor's will not fully penetrate wet or damp surfaces.	Back	Notice (product performance)	Non-Explicit	Before use	Maybe	Yes
Surface should be clean and free from all other coatings.	Back	Notice (product performance)	Non-Explicit	Before use	Maybe	Yes
We recommend a trial patch before you start.	Back	Instruction (product performance)	Non-Explicit	Before use	No	Yes
Application:						
1. For application, both surface and air temperature should be above 40° F.	Back	Notice (product performance)	Non-Explicit	Before use	Maybe	Yes
2. Apply by brush, roller, dipping, or flooding spray.	Back	Instruction	Explicit	During use	Yes	Yes
3. On vertical surfaces, saturate well, apply from bottom up.	Back	Instruction	Explicit	During use	Yes	Yes
4. On horizontal surfaces, saturate well. After 15 minutes, remove puddles by redistributing to dry areas or wiping up.	Back	Instruction	Explicit	During use	Yes	Yes
5. For maximum protection, two coats are recommended.	Back	Notice	Explicit	Before, during, after use	No	Yes
6. To avoid lingering odors in confined areas such as basements, ensure that you have adequate ventilation.	Back	Safety Instruction (precaution)	Non-Explicit	During and after use	Yes	No
7. Not intended for below grade application where water pressure is a problem.	Back	Notice (product performance)	Non-Explicit	Before use	No	No
DRYING TIME: Will vary depending on the surface and humidity. Allow at least 24 to 48 hours.	Back	Instruction	Explicit	After use	No	Yes
Let dry at least 24 hours before applying a second application.	Back	Instruction	Explicit	After use	No	Yes
Allow a minimum of 3 days before painting over Taylor's with oil based paint; 30 days when using top-quality latex paint.	Back	Instruction	Explicit	After use	No	Yes
ADDING TO OIL BASE PAINT OR STAIN: Add Taylor's full strength. Add at least 250 mL (1/2 pint) per 4 litres (gallon) to oil base paint or stain.	Back	Instruction	Explicit	Before use	Maybe	Yes
CLEAN UP: Clean brushes and equipment with paint thinner or mineral spirits.	Back	Instruction	Non-Explicit	After use	Yes	Yes

Condition 2: Procedurally explicit precautions/precautions separate from usage instructions. This condition differed from the first condition in that four key precautions were modified to be more procedurally explicit. The original precautions were modified in the following manner: 1) KEEP AWAY FROM OPEN FLAME OR SPARK was changed to SEARCH FOR AND EXTINGUISH ALL FLAMES AND REMOVE ALL SOURCES OF IGNITION, 2) USE IN A WELL VENTILATED AREA was changed to OPEN WINDOWS TO VENT VAPORS TO OUTDOORS, and 3) AVOID CONTACT WITH EYES AND SKIN was changed to WEAR RUBBER GLOVES AND PROTECTIVE GLASSES. The resulting label is shown in Figure 4.3.

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WHAT IS TAYLOR'S WATER REPELLENT SEALER?

Taylor's is an all purpose, transparent waterproofer that penetrates dry porous materials to seal out water. This establishes a moisture barrier, yet allows the surface to breathe. Taylor's Water Repellent Sealer helps prevent damage for years, even under heavy moisture conditions. Taylor's dries clear so it never changes colour of the treated surface.

TAYLOR'S BENEFITS

WOOD: Ideal for protecting all types of wood, especially **pressure treated** wood. Reduces splitting, grain raising, and deterioration from wetting and drying.
CONCRETE: Waterproofs and seals to reduce spalling (from freeze-thaw) and efflorescence. Protects from de-icing salts and chemicals.
MASONRY/BRICK: Waterproofs dense concrete block, brick and stone and helps prevent spalling and efflorescence.
CANVAS, FABRIC: Waterproofs natural fabric, canvas, tents, tarpaulins, shoes, back-packs, sleeping bags, ground cloths, etc. May slightly darken certain fabrics - try an inconspicuous test patch first.
NOT TO BE USED ON ASPHALT, SYNTHETIC FIBRES, PLASTIC OR NATURAL RUBBER.

DIRECTIONS FOR USE

Surface and substrate must be thoroughly dry. This is very important since Taylor's will not fully penetrate wet or damp surfaces. Surface should be clean and free from all other coatings. We recommend a trial patch before you start.

APPLICATION:

1. For application, both surface and air temperature should be above 40° F.
2. Apply by brush, roller, dipping, or flooding spray.
3. On vertical surfaces, saturate well, apply from bottom up.
4. On horizontal surfaces, saturate well. After 15 minutes, remove puddles by redistributing to dry areas or wiping up.
5. For maximum protection, two coats are recommended.
6. To avoid lingering odors in confined areas such as basements, ensure that you have adequate ventilation.
7. Not intended for below grade application where water pressure is a problem.

DRYING TIME: Will vary depending on the surface and humidity. Allow at least 24 to 48 hours. Let dry at least 24 hours before applying a second application. Allow a minimum of 3 days before painting over Taylor's with oil based paint; 30 days when using top-quality latex paint.

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CLEAN UP: Clean brushes and equipment with paint thinner or mineral spirits.

Distributed by Sealant Products, Urbana, OH 43078

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SEARCH FOR AND EXTINGUISH ALL FLAMES AND REMOVE ALL SOURCES OF IGNITION, including all furnace or stove pilot lights, heaters, candles, and cigarettes – Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire. OPEN WINDOWS TO VENT VAPORS TO OUTDOORS – Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate. WEAR RUBBER GLOVES AND PROTECTIVE GLASSES – This product can cause blindness and severe burns to skin. KEEP OUT OF REACH OF CHILDREN.

PROTECT FROM FREEZING.

FIRST AID TREATMENT: CONTAINS VOLATILE MINERAL SPIRITS. IF SWALLOWED DO NOT INDUCE VOMITING. EYE CONTACT: FLUSH WITH WATER FOR 15 MINUTES. SKIN CONTACT: WASH IMMEDIATELY WITH SOAP & WATER. CALL PHYSICIAN IMMEDIATELY.

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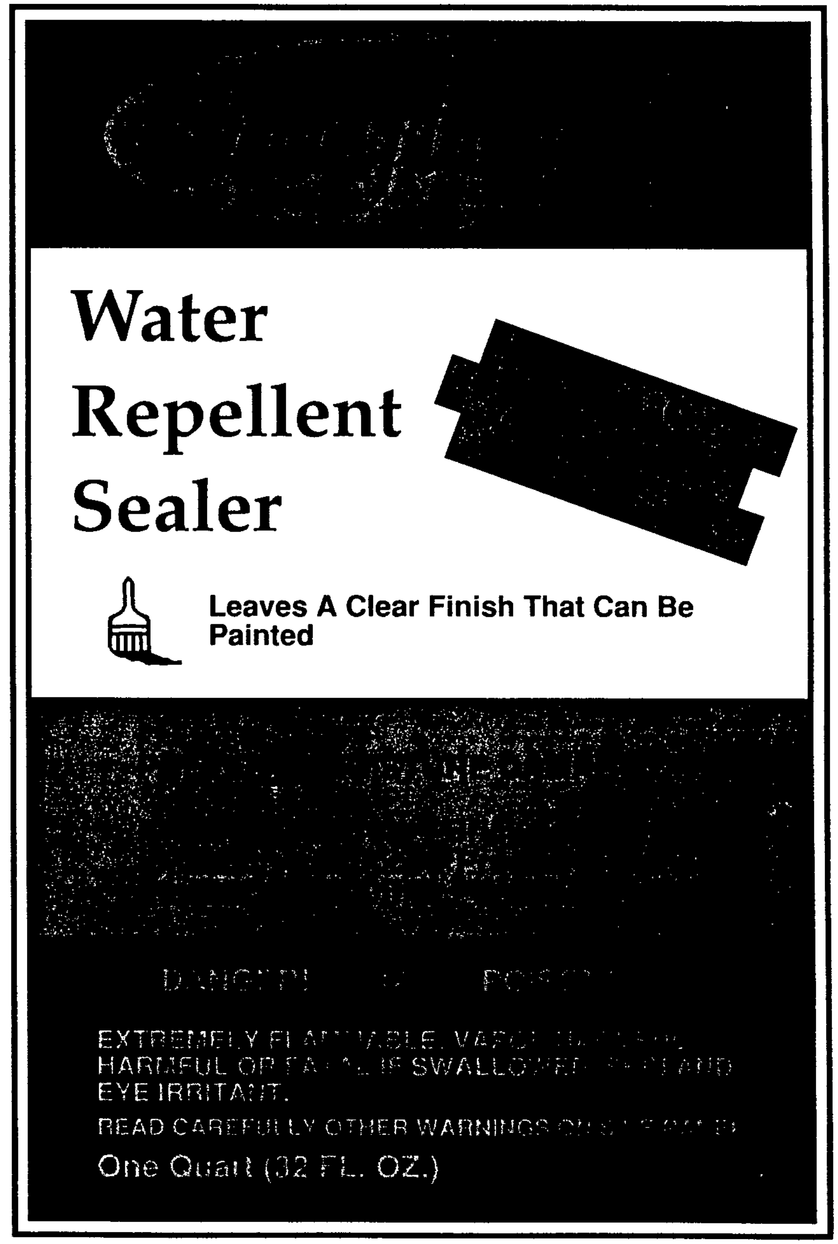
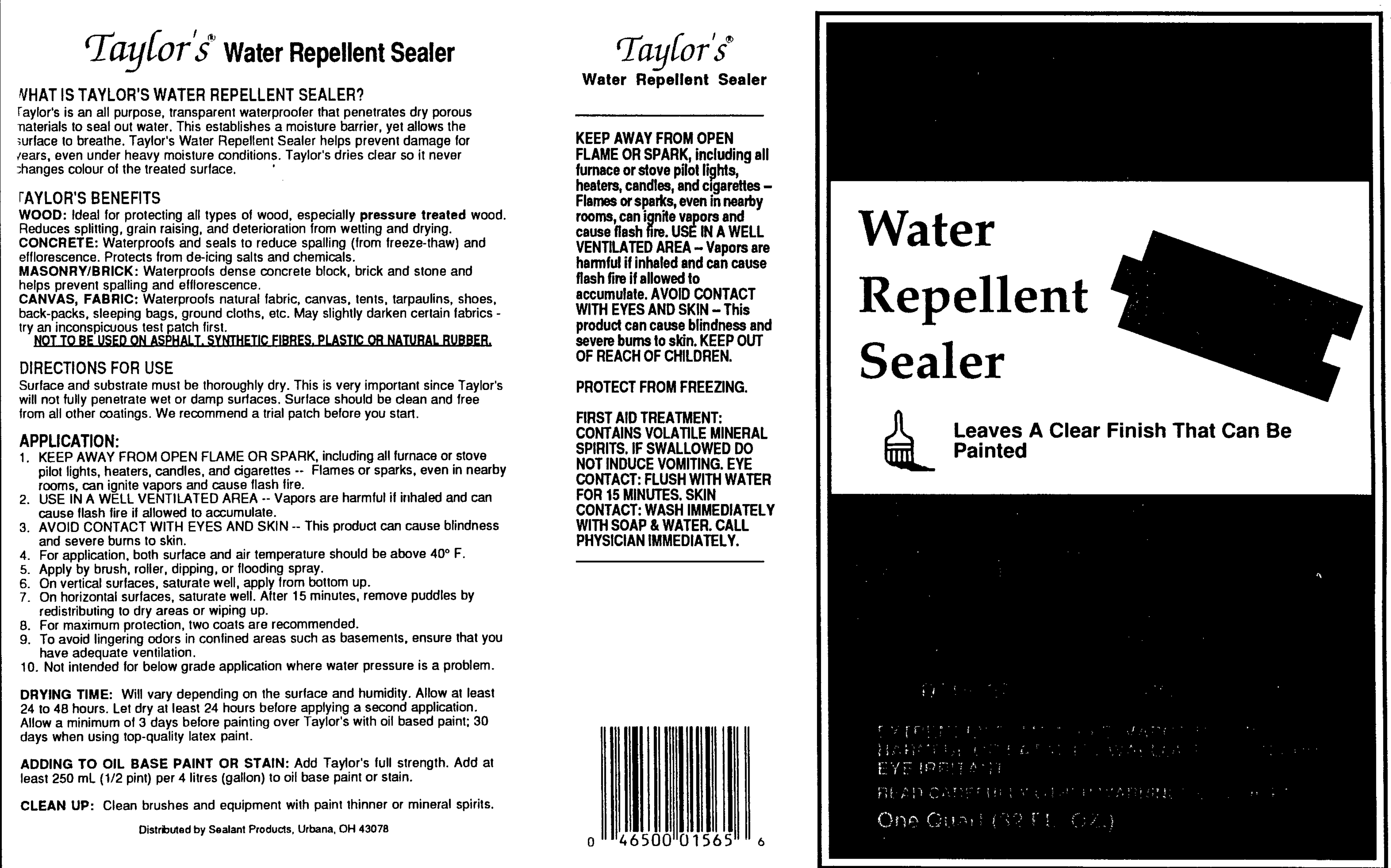


Figure 4.3 *Condition 2: Procedurally Explicit Precautions/Precautions Separate from Usage Instructions.*

Condition 3: Procedurally nonexplicit precautions/precautions integrated into usage instructions. This condition differed from the first condition in that the precautions were integrated into the directions for use section on the back panel of the container. The rule for selecting statements to include in the directions was as follows: If a statement is categorized as a safety instruction and it is an element of the basic level procedure or it has particular or exclusive relevance during the use of the product, then it should be integrated with the directions. The statements that meet these criteria are: KEEP AWAY FROM OPEN FLAME OR SPARK, USE IN A WELL VENTILATED AREA, and AVOID CONTACT WITH EYES AND SKIN. In addition to these precautions, the accompanying explanatory statements were moved to the directions as well. The resulting label is shown in Figure 4.4.

There are two additional points to note about this condition. First, the precautions became the first three steps in the Application section of the label. Second, the safety instructions were added to the back as opposed to moved from the side to the back. Thus, the same information appeared on the back and side of the label. While this decision presents a risk of confounding the effect of warning location with the number of times the statements appear on the label, this strategy was deemed necessary in order to maintain an acceptable sense of reality for companies marketing water sealer products. That is, removing the information from the precautions section would be contrary to the National Paint and Coatings Association's Paint Industry Labeling Guide, contrary to common practice for many similar consumer products, and contrary to an intuitively appealing argument that suggests that people will pay more attention to safety information if it is separated from ordinary nonsafety-critical information. The reality is that, even if there were a marked improvement associated with just moving the precautions into the directions, water sealer manufacturers would still be at risk from the unscientific, empirically unfounded product liability standpoint.



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TAYLOR'S BENEFITS
WOOD: Ideal for protecting all types of wood, especially **pressure treated** wood. Reduces splitting, grain raising, and deterioration from wetting and drying.
CONCRETE: Waterproofs and seals to reduce spalling (from freeze-thaw) and efflorescence. Protects from de-icing salts and chemicals.
MASONRY/BRICK: Waterproofs dense concrete block, brick and stone and helps prevent spalling and efflorescence.
CANVAS, FABRIC: Waterproofs natural fabric, canvas, tents, tarpaulins, shoes, back-packs, sleeping bags, ground cloths, etc. May slightly darken certain fabrics - try an inconspicuous test patch first.
NOT TO BE USED ON ASPHALT, SYNTHETIC FIBRES, PLASTIC OR NATURAL RUBBER.

DIRECTIONS FOR USE
Surface and substrate must be thoroughly dry. This is very important since Taylor's will not fully penetrate wet or damp surfaces. Surface should be clean and free from all other coatings. We recommend a trial patch before you start.

APPLICATION:
1. KEEP AWAY FROM OPEN FLAME OR SPARK, including all furnace or stove pilot lights, heaters, candles, and cigarettes -- Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire.
2. USE IN A WELL VENTILATED AREA -- Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate.
3. AVOID CONTACT WITH EYES AND SKIN -- This product can cause blindness and severe burns to skin.
4. For application, both surface and air temperature should be above 40° F.
5. Apply by brush, roller, dipping, or flooding spray.
6. On vertical surfaces, saturate well, apply from bottom up.
7. On horizontal surfaces, saturate well. After 15 minutes, remove puddles by redistributing to dry areas or wiping up.
8. For maximum protection, two coats are recommended.
9. To avoid lingering odors in confined areas such as basements, ensure that you have adequate ventilation.
10. Not intended for below grade application where water pressure is a problem.

DRYING TIME: Will vary depending on the surface and humidity. Allow at least 24 to 48 hours. Let dry at least 24 hours before applying a second application. Allow a minimum of 3 days before painting over Taylor's with oil based paint; 30 days when using top-quality latex paint.

ADDING TO OIL BASE PAINT OR STAIN: Add Taylor's full strength. Add at least 250 mL (1/2 pint) per 4 litres (gallon) to oil base paint or stain.

CLEAN UP: Clean brushes and equipment with paint thinner or mineral spirits.

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PROTECT FROM FREEZING.

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0 46500 01565 6

Water
Repellent
Sealer

Leaves A Clear Finish That Can Be Painted

One Quart (32 FL. OZ.)

Figure 4.4 *Condition 3: Procedurally Nonexplicit Precautions/Precautions Integrated into Usage Instructions.*

Condition 4: Procedurally explicit precautions/precautions integrated into usage instructions. The final condition was a combination of Conditions 2 and 3. The precautions identified in the Multi-Attribute Analysis were added to the directions for use and they were modified to be more procedurally explicit. This label, which was hypothesized to be the most effective, is shown in Figure 4.5.

Subjects

The same 80 subjects who participated in the first experiment participated in this experiment. Twenty subjects were randomly assigned to one of four conditions. However, since the experimental product used in this experiment was used after the drain opener, special measures were taken to avoid carry-over effects. Namely, subjects were assigned to 1 of 16 possible combinations of experimental conditions (there were 4 conditions in each of the experiments). Thus, each subject had an equal chance of being assigned to each condition in the first experiment and each condition in the second experiment, and each condition in the second experiment followed each condition the first experiment the same number of times.

Experimental Design

The experiment was a 2 x 2, between-subjects design. Dependent measures included behavioral compliance with instructions and warnings and text processing measures such as self-reported reading of instructions, self-reported attention to various label components, and observed viewing times for panels of the container. In addition, subjective ratings of product hazardousness and the reasons for not complying with

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3. WEAR RUBBER GLOVES AND PROTECTIVE GLASSES -- This product can cause blindness and severe burns to skin.
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9. To avoid lingering odors in confined areas such as basements, ensure that you have adequate ventilation.
10. Not intended for below grade application where water pressure is a problem.

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PROTECT FROM FREEZING.

FIRST AID TREATMENT: CONTAINS VOLATILE MINERAL SPIRITS. IF SWALLOWED DO NOT INDUCE VOMITING. EYE CONTACT: FLUSH WITH WATER FOR 15 MINUTES. SKIN CONTACT: WASH IMMEDIATELY WITH SOAP & WATER. CALL PHYSICIAN IMMEDIATELY.

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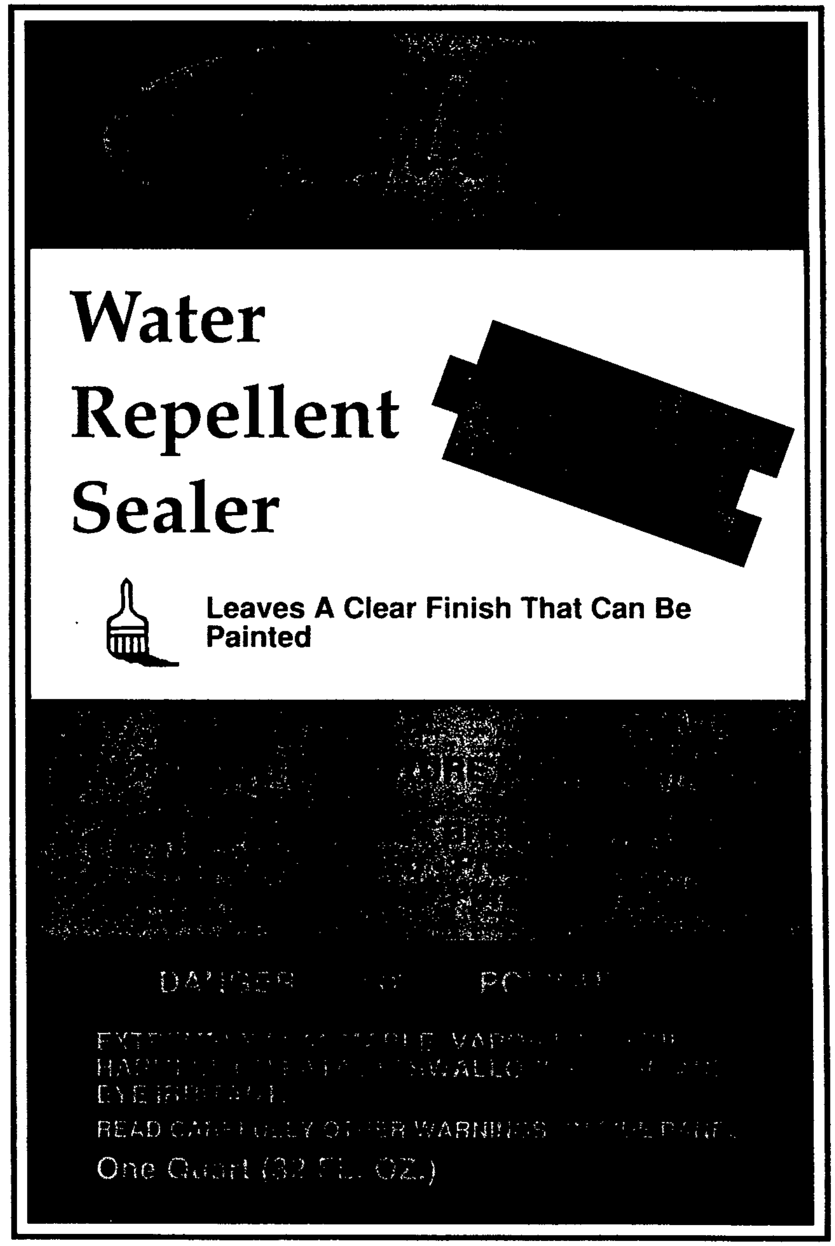

Figure 4.5 *Condition 4: Procedurally Explicit Precautions/Precautions Integrated into Usage Instructions.*

instructions were obtained. Finally, subject characteristics including age and experience with water sealers were gathered.

Procedure

The procedure for recruiting and instructing subjects was that described in Experiment 1. Recall that subjects were told that a scented candle had been lit, in order to freshen the air prior to the arrival of their guests. Also, the experiment ended as soon as the subject began applying the water sealer.

Stimulus Materials

Product and labels. The water repellent sealer was provided in a one quart metal container which formerly held another woodworking substance. The container was filled with a mixture of water, rice wine vinegar, and a very small amount of food coloring to keep the liquid from appearing to be water. It should be noted that, since the experiment stopped as soon as the subject began to apply the water sealer, the similarity of this liquid to actual water repellent sealer was not nearly as important as the drain opener appearing to be lye crystals.

The labels were professionally prepared, printed, and affixed to the cans. To enhance the fidelity of the fictitious product, the label included such details as a bar code (UPC) and an actual price tag was affixed to the product.

Experimental workspace. As described in the first experiment, the workspace was the kitchen in a residence a few blocks from campus. The water sealer container was placed in the cabinet under the sink (see Figure 3.7). Gloves and goggles were adjacent to the water sealer and aluminum pans and brushes were behind the water sealer. The wooden plant stand which was to be sealed was on the kitchen counter next to the sink.

Above the sink and just to the left of the plant stand was a window which slid on a horizontal track. Also, a scented candle burned openly approximately five feet away from the plant stand.

Results

Compliance Data

Compliance rates across conditions. Through hidden camera observation and post-task interviews, behavioral compliance with four safety instructions was measured. Since the safety instructions prescribe actions to be taken prior to product use, these four instructions will be referred to as precautions. Table 4.2 lists the four precautions along with the compliance criterion for each. The percentage of subjects in each condition complying with the precautions is shown in Figure 4.6 and Table 4.3.

Table 4.2

Water sealer precautions and their accompanying compliance criteria.

Precaution	*Criterion for Compliance*
Keep away from open flame or spark*/Search for and extinguish all flames and remove all sources of ignition**	Extinguish candle before applying sealer
Use in a well ventilated area*/Open windows to vent vapors to outdoors**	Open window above sink before applying sealer
Avoid contact with eyes*/Wear protective glasses**	Wear goggles while applying sealer
Avoid contact with skin*/Wear rubber gloves**	Wear rubber gloves while applying sealer

* Nonexplicit version
** Explicit version

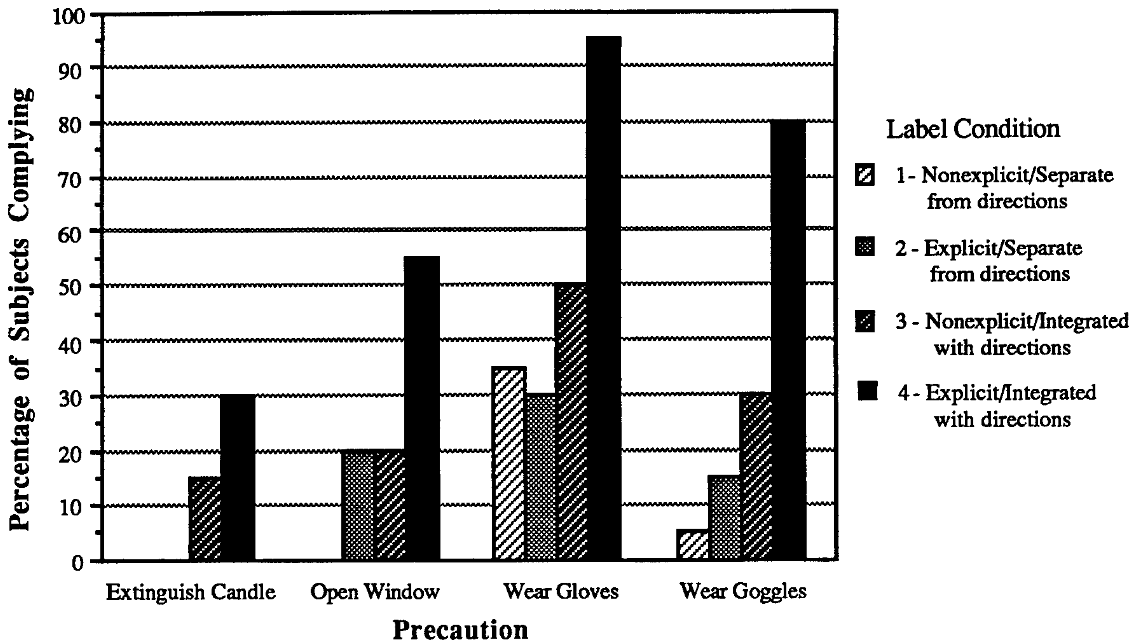

Figure 4.6 *Percentage of subjects in each condition complying with precautions.*

Table 4.3

Percentage of subjects in each condition complying with precautions.

Precaution	*Condition* 1 Nonexplicit/ Separate from Directions*	2 Explicit/ Separate from Directions	3 Nonexplicit/ Integrated with Directions	4 Explicit/ Integrated with Directions
Extinguish candle	0%	0%	15%	30%
Open window	0%	20%	20%	55%
Wear rubber gloves	35%	30%	50%	95%
Wear goggles	5%	15%	30%	80%

* current practice

Effect of presentation factors on compliance. Chi-square tests were conducted to analyze the effect of precaution location and procedural explicitness on compliance with each of the four precautions. The effect of location was significant for all four precautions: extinguish candle, χ^2 (1) = 10.1, N = 80, $p < 0.01$, open window, χ^2 (1) = 8.4, N = 80, $p < 0.01$, wear goggles, χ^2 (1) = 18.5, N = 80, $p < 0.01$, wear rubber gloves, χ^2 (1) = 12.8, N = 80, $p < 0.01$. Thus, placing the precautions in the directions for use significantly increased the proportion of subjects complying with each precaution. In fact, combining the compliance rates for the four precautions, the average rate of compliance was 13% when the precautions did not appear in the usage instructions and 47% when they were included in the usage instructions.

The effect of procedural explicitness was significant for two of the four precautions: open window, χ^2 (1) = 8.4, N = 80, $p < 0.01$, and wear goggles, χ^2 (1) = 8.2, N = 80, $p < 0.01$. Increasing the procedural explicitness of these two precautions increased the proportion of subjects complying with them. The effect of procedural explicitness did not significantly increase the proportion of subjects extinguishing the candle ($p > 0.1$) or wearing gloves ($p > 0.05$). Across the four precautions, the average rate of compliance was 19% when the precautions were presented in a procedurally nonexplicit manner and 41% when they were procedurally explicit.

Another means of assessing the effect of presentation factors is to consider the overall behavioral effectiveness of each experimental label. To do this, a composite measure or Precaution Compliance Score was constructed by summing the number of precautions taken by each subject. Figure 4.7 shows the mean Precaution Compliance Scores for each condition. An analysis of variance of the compliance scores revealed a significant main effect of precaution location, $F(1,76) = 40.3$, $p < 0.01$, a significant main effect of procedural explicitness, $F(1,76) = 16.0$, $p < 0.01$, and a significant interaction effect, $F(1,76) = 8.0$, $p < 0.01$. Using the Fisher test, the pairwise differences between the four conditions were analyzed. All pairwise differences were significant ($p < 0.05$)

except for the differences between Conditions 1 and 2, and Conditions 2 and 3. That is, when the precautions appeared only on the side of the container, changing the explicitness of the precautions did not significantly change the Precaution Compliance Score. And, procedurally nonexplicit precautions included in the directions for use did not produce significantly greater compliance scores than explicit precautions appearing only on the side of the container.

A final point regarding the behavioral effectiveness of different label conditions is the difference between the average rate of compliance associated with the exemplar current label versus that of the label condition hypothesized to be the most effective (i.e., Condition 4). Averaging compliance rates for all four precautions, it was found that compared to the exemplar current label (Condition 1), the label with procedurally explicit precautions included in the directions for use (i.e., Condition 4) increased the compliance rate from 10% to 65%.

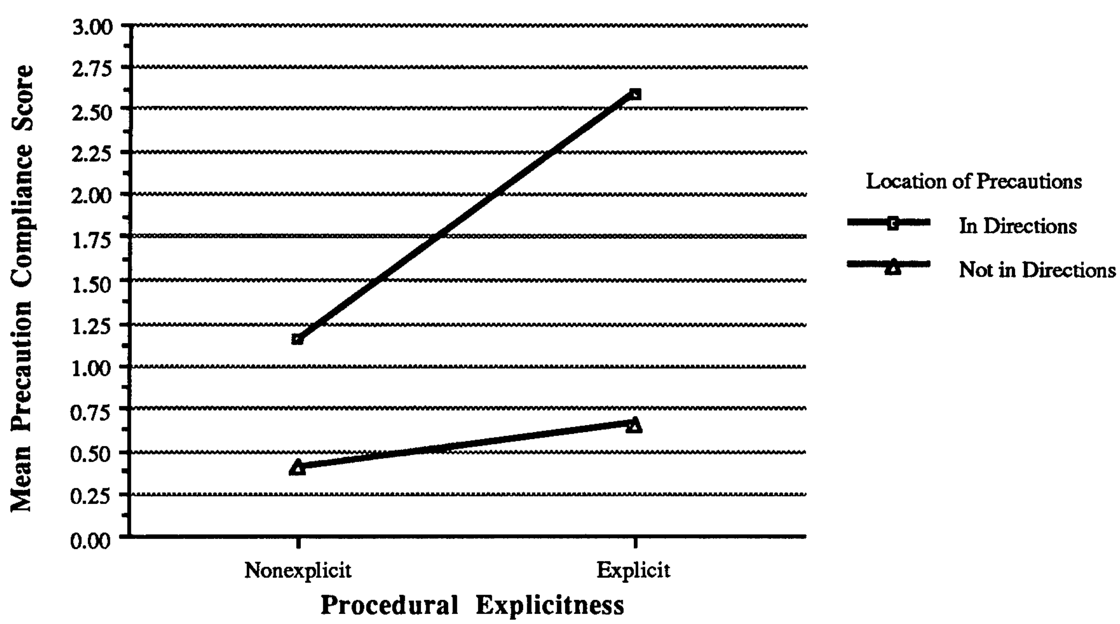

Figure 4.7 *Mean Precaution Compliance Scores for label conditions (max. score = 4).*

Text Processing Data

Self-reported reading of precautions. During the post-task interview, subjects were asked to explain why they did or did not perform each of the four precautionary actions. As part of this questioning, subjects were queried as to whether or not they read the precautions. In the context of this experiment, the term reading refers to processing the precautionary text such that the context-specific actions were understood by the subject. This qualification is important for two reasons. First, a number of subjects read only the initial portion of a precautionary statement (e.g., keep away from open flame or spark) which prescribed a generic precaution. As a result of this partial processing, some subjects did not read and understand the specific precautionary actions required for this particular setting (e.g., extinguish candle). Second, several subjects recalled reading a precautionary statement in its entirety (e.g., use in a well ventilated area), but did not interpret or recognize that the statement implied a specific action to be taken (e.g., open window). In other words, the measure of reading in this experiment provides an indication of the label's context-specific message communication effectiveness. Thus, in this experiment if a subject "read" a precaution it means that, as a result of processing the information on the label, he/she recognized the context-specific actions to be taken.

The percentage of subjects who reported reading each of the four precautions is shown in Figure 4.8 and Table 4.4. Chi-square tests were conducted to analyze the effect of precaution location and procedural explicitness on reading of each of the four precautions. The effect of location was significant for all four precautions: extinguish candle, χ^2 (1) = 18.5, N = 80, $p < 0.01$, open window, χ^2 (1) = 11.3, N = 80, $p < 0.01$, wear goggles, χ^2 (1) = 30.8, N = 80, $p < 0.01$, wear rubber gloves, χ^2 (1) = 37.1, N = 80, $p < 0.01$. Thus, placing the precautions in the directions for use section significantly increased the proportion of subjects who read the precautions (and recognized the specific

action to be taken). In fact, combining the reading rates from the four precautions, the average reading rate was 9 percent when the precautions did not appear in the usage instructions and 59 percent when they were included in the usage instructions.

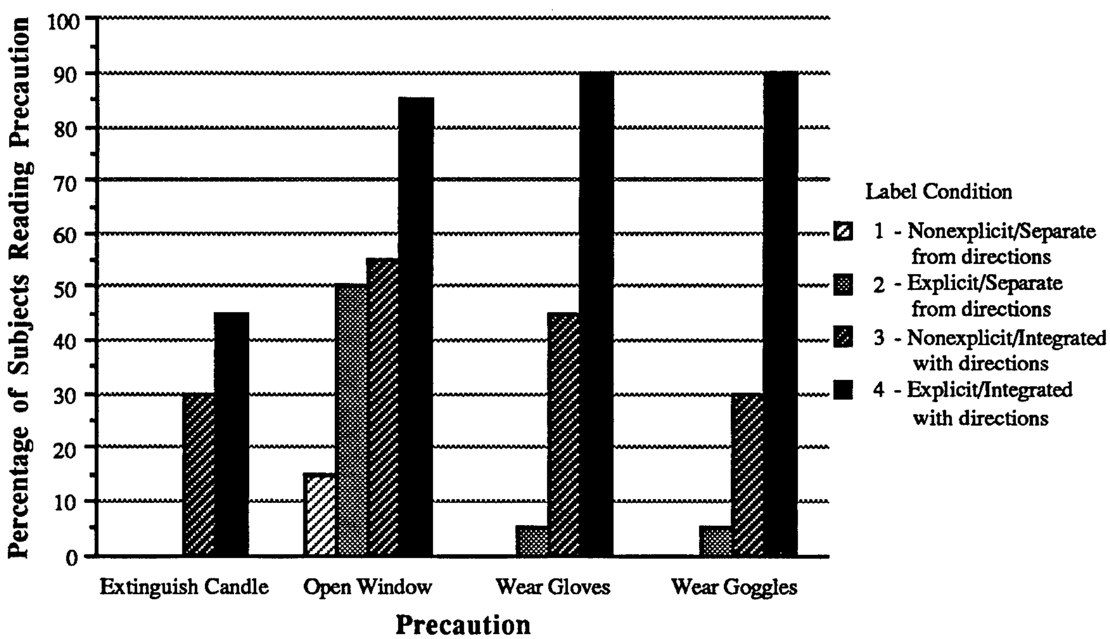

Figure 4.8 *Percentage of subjects in each condition who reported reading each of the precautions.*

The effect of procedural explicitness was significant for three of the four precautions: open window, χ^2 (1) = 8.5, N = 80, $p < 0.01$, wear goggles, χ^2 (1) = 9.8, N = 80, $p < 0.01$, and wear rubber gloves, χ^2 (1) = 5.5, N = 80, $p < 0.05$. For each of these three precautions, increasing the procedural explicitness increased the proportion of subjects who read the precaution (and recognized the specific action to be taken). The effect of procedural explicitness was not significant for the precaution to extinguish the candle ($p > 0.1$). Across the four precautions, the average reading rate was 22 percent when the precautions were presented in a procedurally nonexplicit format and 46 percent when they were procedurally explicit. Thus, the effect of the explicitness factor was not as large as that for the location factor.

Table 4.4

Percentage of subjects in each condition who reported reading each of the precautions.

	Condition			
Precaution	*1 Nonexplicit/ Separate from Directions**	*2 Explicit/ Separate from Directions*	*3 Nonexplicit/ Integrated with Directions*	*4 Explicit/ Integrated with Directions*
Extinguish candle	0%	0%	30%	45%
Open window	15%	50%	55%	85%
Wear rubber gloves	0%	5%	45%	90%
Wear goggles	0%	5%	30%	90%

* current practice

In examining Figure 4.8 and Table 4.4, it is important to recall that Condition 1 was fashioned after a commercially available water sealer and is representative of the current state of product information design. The remaining conditions, however, represent incremental improvements to the label based on a systematic design which included consideration of the cognitive aspects of task performance. More specifically, compared to the exemplar current label, procedurally explicit precautions included in the directions for use (i.e., Condition 4) increased the average reading rate for a precaution from 4% to 78%.

Another interesting result is that, although the vapor flammability hazard appeared both at the beginning of the directions for use and in the precautions section, fewer subjects read and recognized the specific precaution to be taken than for the other three precautions that appeared after the flammability statement. This result suggests that subjects began filtering out text even at the beginning of their text-level processing and that placing the flammability precaution at the beginning of a set of procedures did not produce the primacy advantage that one might expect.

As with the compliance data, another means of assessing the effect of presentation factors on the reading of precautions is to develop an overall measure of reading for each label. To do this, a composite measure or Precaution Reading Score was constructed by summing the number of precautions that each subject read. Figure 4.9 shows the mean Precaution Reading Score for each condition. Analyses of variance of the reading scores revealed a significant main effect of precaution location, $F(1,76) = 84.8$, $p < 0.01$, a significant main effect of procedural explicitness, $F(1,76) = 20.7$, $p < 0.01$, and a significant interaction effect between the two factors, $F(1,76) = 6.0$, $p < 0.05$. Using the Fisher test, the pairwise differences between the four conditions were analyzed. All pairwise differences were significant ($p < 0.05$) except for the differences between Conditions 1 and 2.

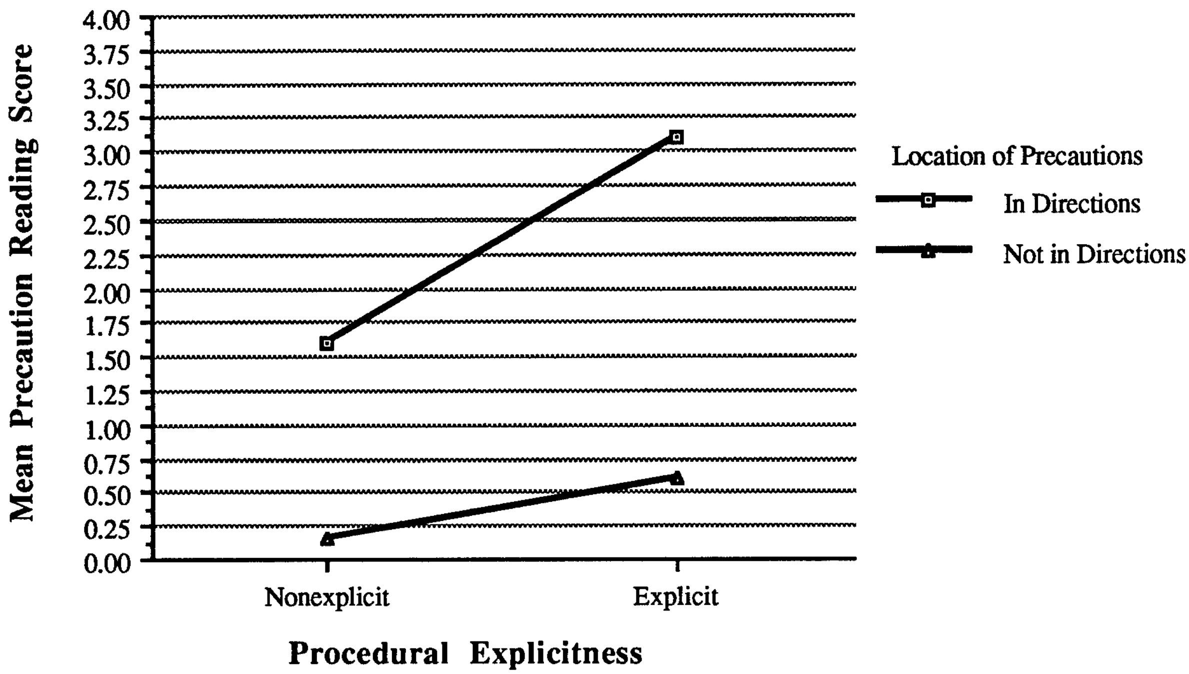

Figure 4.9 *Mean Precaution Reading Score for each condition (max. score = 4).*

Self-reported attention to label components. Another means of assessing users' processing of the label information was to ask the subjects to describe the amount of information that they read on the front, back, and side panels of the water sealer container. A seven point scale with verbal anchors ranging from reading none of the information to all of the information was used. Using the same scale, subjects were asked to describe the amount of information they read in each of the three sections on the back of the label (i.e., What is Taylor's water repellent sealer, Taylor's benefits, and Directions for use). The mean ratings for each panel of the container and for each section of the back of the label are shown in Figure 4.10.

This figure illustrates that the reading ratings varied considerably across panels of the container and sections of the back panel, but there was relatively little variation between

label conditions for a given panel or section. Indeed, using the Kruskal-Wallis test, the variation in reading ratings between label conditions was found to be statistically insignificant for all of the panels and sections of the back panel ($p > 0.10$).

Because the reading ratings did not differ significantly between experimental conditions, the responses were collapsed across conditions to assess the differences in reading ratings between the different panels. Using the Friedman test, the difference between reading ratings for the three panels was assessed. The test was significant, $\chi_r(2) = 110.6$, $p < 0.01$, indicating that reading ratings for at least two of the panels differed significantly. Pairwise comparisons of the reading ratings were then conducted using the Wilcoxon signed-rank test. The reading ratings for the back panel were significantly greater than the ratings for the front ($p < 0.01$), which, in turn, were significantly greater than the reading ratings for the side panel ($p < 0.01$).

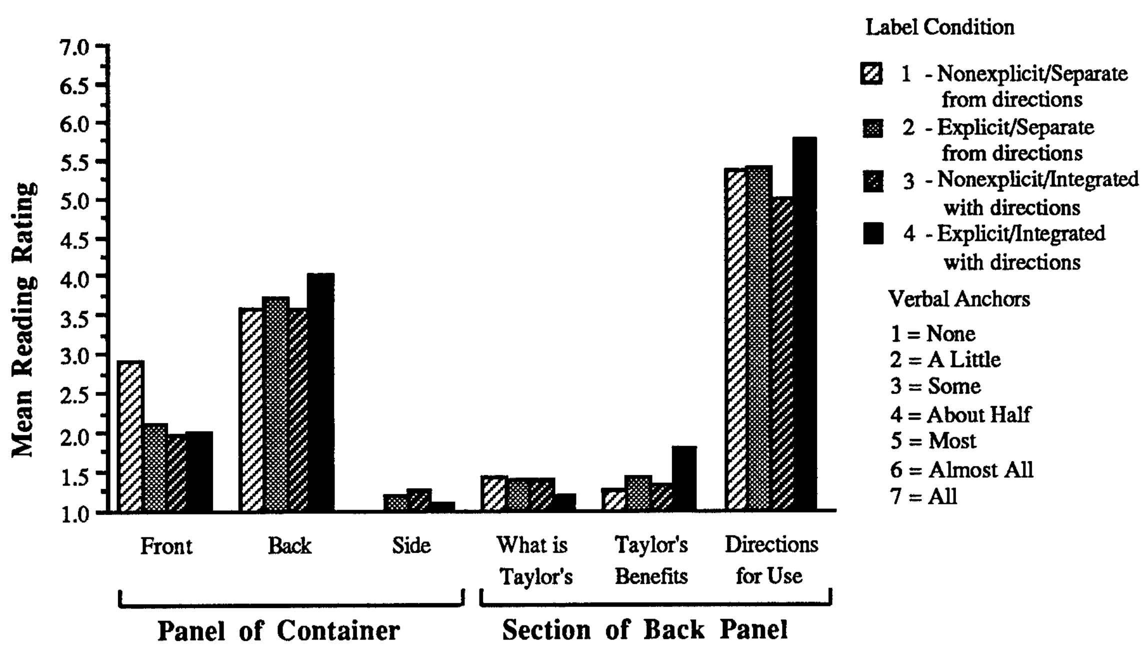

Figure 4.10 *Mean reading ratings for each panel of the container and each section of the back of the label.*

With regard to the sections on the back of the label, the Friedman test found that the reading ratings for at least two sections differed significantly, $\chi_r(3) = 118.9$, $p < 0.01$. Using the Wilcoxon signed-rank test, it was found that subjects read a greater proportion of the directions for use than they did for the "Taylor's Benefits" section ($p < 0.01$) or the "What is Taylor's" section ($p < 0.01$), however, the difference between the latter two sections was not significant ($p > 0.10$).

A final point regarding the attention to various panels of the container is that 77 of the 80 subjects (96%) reported that they read <u>none</u> of the information on the side of the container. This result is consistent with the responses to a question asked of subjects in Conditions 3 and 4 where the precautions appeared on the side of the container and in the directions for use on the back, "Did you notice that some of the information on the side of the container also appeared on the back of the container?" Thirty-eight of the 40 subjects (95%) did not notice that any information appeared in both places. One of the two subjects who did notice that some of the same information appeared on both panels recalled that the common message was that the product was very flammable and the other subject recalled that both panels indicated that he should keep the product out of his eyes, wear gloves, and that the product was flammable. Both subjects indicated that the repeated exposure to the same precautions did not affect their decision to comply or not comply with the precautions. Collectively, the results indicate that meaningful attention to the side panel was rare and that adding precautions to the back panel instead of moving the information from the side to the back did not present a significant confound in the experiment.

<u>Observed viewing times for panels of container</u>. In addition to the subjects' reading ratings, the amount of time subjects spent viewing the front, back, and side panels of the container (i.e., label) was measured. As previously described, the time measurements were taken from a counter superimposed on the video tapes of the experimental sessions and they were extracted from the video tapes by a research assistant who was unaware of

the research hypotheses. Complete viewing time data were obtained for 70 of the 80 subjects. Complete data were obtained from at least 17 subjects in each experimental condition.

Table 4.5 shows the mean viewing times for each panel of the water sealer container. An analysis of variance was conducted to determine the effect of label panel on viewing time. The variability in viewing times between label panels was found to be significant, $F(2, 207) = 116.1$, $p < 0.01$. In addition, pairwise comparisons using the Scheffe F-test revealed that the viewing time for the back panel was significantly longer than for the front panel and side panel ($p < 0.01$), however, the viewing time for the front and side panels did not differ significantly ($p > 0.10$). More specifically, the viewing time for the back panel was greater than for the front panel by an average of 41.5 seconds, and the viewing time for the back panel was greater than for the side by an average of 42 seconds. With respect to the side panel where the precautions always appeared, 54 of the 70 subjects for which complete viewing time data were obtained spent no measurable time viewing the side panel.

Table 4.5

Viewing times for each panel of the water sealer container (N = 70).

Panel of Container	*Mean Viewing Time (seconds)*
Front	2.10 (0.35)
Back	43.57 (3.78)
Side	1.55 (0.79)

Standard errors appear in parentheses.

With regard to the effect of presentation factors on the amount of time subjects spent viewing the different panels, a series of two-factor analyses of variance found that the location of precautions and procedural explicitness factors did not significantly affect the viewing times for front, back, and top panels ($p > 0.05$). In fact, the time spent viewing all three panels combined was not significantly affected by the presentation factors ($p > 0.10$). The finding that the amount of time spent viewing the label did not differ across experimental conditions is interesting in light of the fact that, as previously described, attention to and compliance with label precautions did vary significantly and substantially across experimental conditions.

Relationship Between Reading and Complying with Precautions

One way to assess the effectiveness of a warning or instruction is to contrast how users would behave in the absence of or inattention to written instructions and warnings and how they would behave given that they attended to the written information. Table 4.6 illustrates the percentage of subjects who complied with the four precautions given that they did/did not read a particular precaution. For subjects who read a precaution, the rate of compliance was higher than for subjects who did not read. In fact, averaging across the precautions, 73 percent of the subjects took a precaution given that they read it, versus 9 percent took a precaution given that they did not read it.

Although only a small proportion of subjects who didn't read the precautions wore gloves and goggles, Figure 4.11 illustrates that the number of subjects who took these precautions was greater than the number of subjects who read these precautions. This is an indication that cues other than written information prompted some subjects to take these precautions.

Table 4.6

Percentage of subjects complying with precautions given that they did/did not read the precaution.

Precaution	*Percentage of Subjects Complying With Instruction Given Subject:* Read Instruction	Did Not Read Instruction
Extinguish candle	60%	0%
Open window	46%	0%
Wear goggles	88%	7%
Wear rubber gloves	96%	29%
Mean Compliance Rate	73%	9%

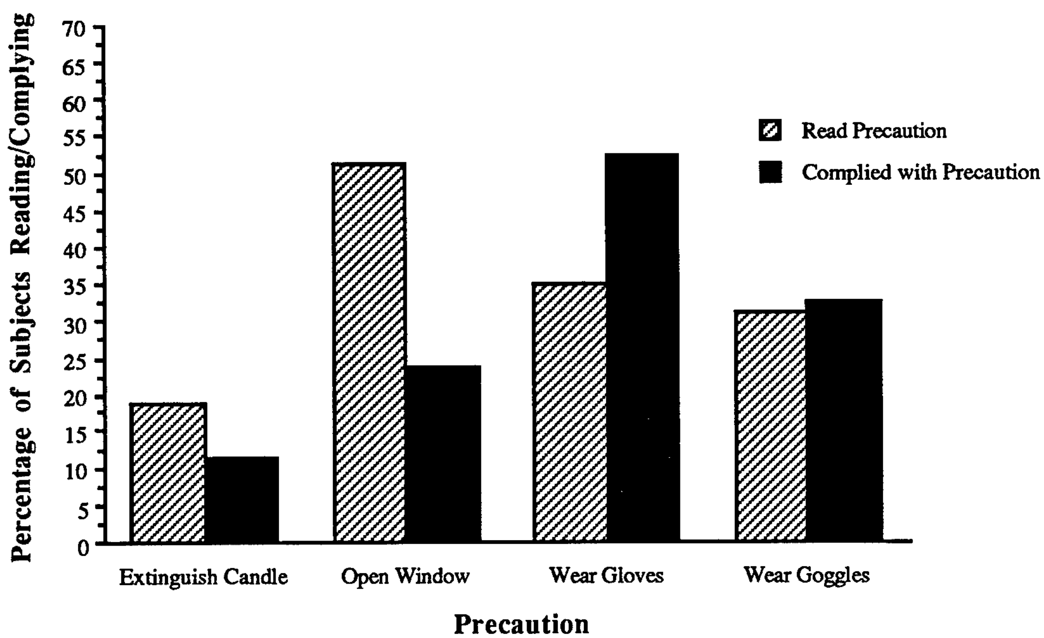

Figure 4.11 *Percentage of subjects who reported reading each precaution and percentage of subjects who complied with each precaution.*

Effect of Subject Characteristics on Attention to and Compliance with Instructions

In addition to the two presentation factors, the effect of several subject characteristics on the attention to and compliance with instructions was examined using the reading and compliance composite scores previously described. The subject characteristics evaluated were gender, age, and prior experience using water sealer products.

Gender. Since an equal proportion of males and females were assigned to each condition, the responses from all four conditions were pooled to analyze the effect of gender on the Precaution Compliance Score and the Precaution Reading Score. Analyses of variance found that gender did not significantly affect either of the scores ($p > 0.10$).

Age. With respect to age, an analysis of variance found that age did not differ significantly across the four experimental conditions and, as a result, subjects were pooled from all four conditions to analyze the effect of age. Regression analysis found that age was not significantly related to either the reading or compliance scores ($p > 0.10$). This finding is not surprising considering the limited variability in subject age.

Experience with water sealer products. Subject experience with water sealers was assessed using the same questions as for the drain opener. The responses were subjected to a principal components analysis. The results of the principal components analysis are shown in Table 4.7. This table illustrates that a single component accounted for 72% of the variance. The loadings for Component 1 were combined with the standardized measures obtained from the subjects to produce an overall measure of experience for water sealer products. The resulting experience scores for the subjects were used to determine the effect of experience on the reading and compliance composite scores.

As with age, an analysis of variance found that water sealer experience scores did not differ significantly between the four experimental conditions which allowed the scores to be pooled together. The reading and compliance scores were regressed on the water

sealer experience scores. No significant relationships were found between the experience scores and either the reading or compliance scores ($p > 0.10$).

The interaction between experience with water sealers and label condition was also assessed. Subjects were placed into one of two experience categories, those with no experience using or purchasing water sealers and those with at least some experience. The interaction between label condition and level of experience was not significant ($p > 0.10$).

As with the drain opener experiment, it is important to note that, by design, the degree of experience with water sealer products did not vary a great deal across subjects. Figure 4.12 illustrates that the majority of subjects had very little experience purchasing and using water sealer products. This result is expected since one objective in selecting an experimental product, task, and subject was to create a situation in which users would have difficulty relying solely on their previous experiences and would likely seek some form of external information. The implication of this limited range of subject experience is that it is possible that, given a broader range of subject experience, a relationship might exist between experience and attention to and compliance with instructions.

Table 4.7

Component loadings for measures of experience with water sealer products.

Measured Experience Variable	*Component*			
	1	*2*	*3*	*4*
Number of times used water sealer	0.848	-0.414	0.329	0.048
Last time used water sealer	0.792	-0.530	-0.300	-0.039
Number of times purchased water sealer	0.887	0.428	0.066	-0.159
Last time purchased water sealer	0.874	0.448	-0.114	0.150
Percent of Total Variance Explained by Components	72.42%	20.90%	5.39%	1.29%

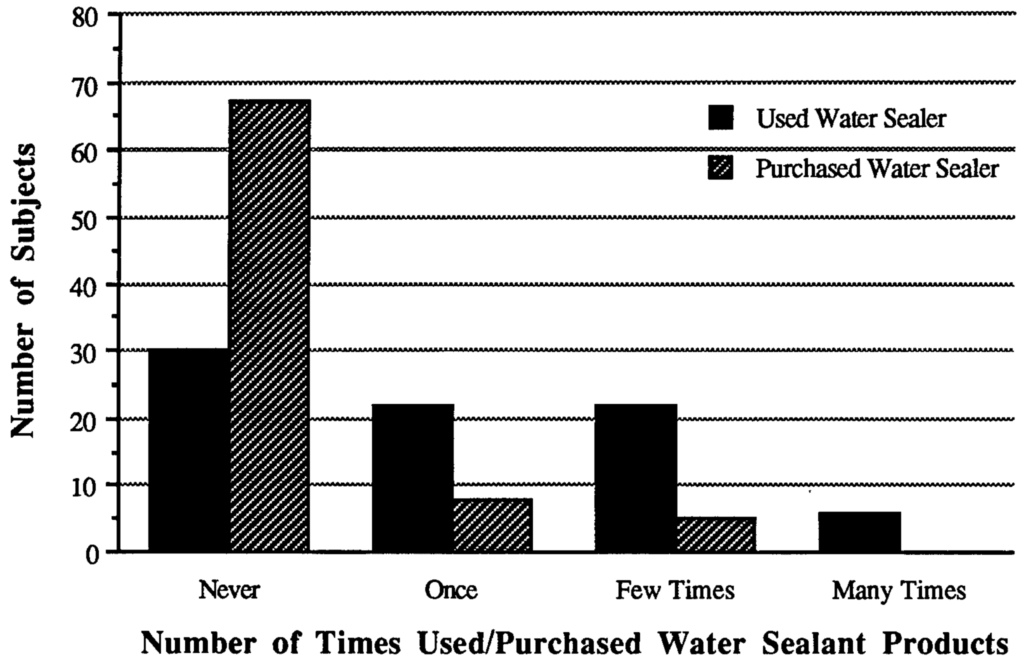

Figure 4.12 *Distribution of responses to the question, "How many times have you used/purchased a water sealant product?"*

Perceived Hazardousness

During the post-task interview subjects were asked, "In your opinion, how hazardous is the water repellent sealer to use?" They were provided with a seven-point, bipolar scale ranging from not very hazardous to very hazardous. Note that the response to this question provides a measure of perceived hazardousness after using the product as opposed to before using the product. Thus, for purposes of this experiment, the rating of hazardousness is considered a dependent measure rather than an independent measure that could be causally linked to the attention to and compliance with the precautions.

The primary reason for measuring subject perceptions of product hazards was to determine how changes in the presentation of product information might affect users' overall assessment of product hazardousness. The mean hazardousness ratings for each level of the two presentation factors are shown in Figure 4.13. The effect of precaution location on the rating of product hazardousness was significant, $F(1,76) = 6.14$, $p < 0.05$, however, the effect of procedural explicitness was not significant ($p > 0.10$), nor was the interaction effect significant ($p > 0.10$).

Significant positive correlations were found between rating of product hazardousness and the Precaution Compliance Score ($r = 0.47$, $p < 0.01$) and the Precaution Reading Score ($r = 0.39$, $p < 0.01$). Thus, the more precautions subjects read/complied with, the greater the perceived hazardousness associated with using the product.

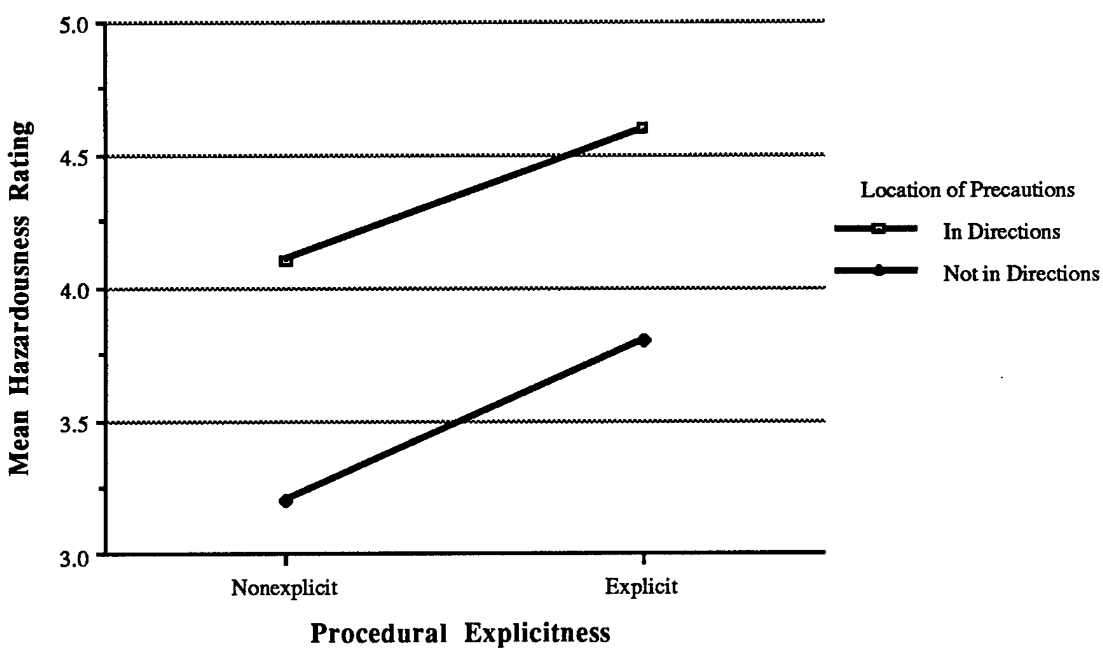

Figure 4.13. *Mean hazardousness ratings for each level of the two presentation factors (seven point rating scale).*

In addition, significant positive correlations were found between the perceived hazardousness of the product and amount of time spent viewing the back panel ($r = 0.34$, $p < 0.01$), the front panel ($r = 0.44$, $p < 0.01$), and the side panel ($r = 0.28$, $p < 0.05$). There was also a significant positive correlation between the total viewing for all panels and the rating of product hazardousness ($r = 0.39$, $p < 0.01$). Thus, the more time subjects spent viewing the front, back, and side panels of the container the higher the rating of product hazardousness.

With regard to the relationship between subject characteristics and perceived hazardousness, reliable correlations were not found between hazardousness ratings and gender ($r = 0.16$, $p > 0.1$), age ($r = 0.08$, $p > 0.1$), or experience with water sealer products ($r = 0.20$, $p > 0.05$).

In summary, the only independent variable significantly correlated with the perceived hazardousness was the location of precautions relative to the usage instructions -- the water sealer was perceived to be more hazardous when the precautions were added to the directions for use. No other label or subject attribute was reliably related to the rating of product hazardousness.

Reasons for Not Complying with Precautions

During the post-task interview, subjects who read but did not comply with a precaution were asked their reasons for noncompliance. The reasons for knowingly not complying with precautions can be separated into two categories: 1) forgetting to comply, and 2) deciding not to comply. In the vast majority of cases, subjects decided not to comply as opposed to forgot to comply. More specifically, across all precautions, there were 28 occurrences of subjects deciding not to comply with a precaution versus 4 occurrences of subjects reading a precaution and forgetting to comply.

Once again, it is important to note that the reasons provided by subjects for not complying with instructions are susceptible to such problems as subjects reporting logical reasons for their behavior without having an actual recollection and subjects reporting socially desirable reasons for their behavior.

Deciding not to take precautions. The "open window" precaution produced the greatest number of subjects who decided not to comply with a precaution. Twenty-two subjects decided not to open the window above the sink; 17 of those subjects either assumed that the room was sufficiently ventilated or felt that it just wasn't necessary to open the window, 3 subjects decided to wait until the odor from the fumes became a problem before opening the window, another subject thought that application temperature might fall below the recommended 40° F temperature, and the final subject did not want to open the window because it didn't have a screen. With respect to wearing rubber gloves, one subject decided not to wear rubber gloves after reading the precaution because he felt that there was no hazard since he could handle a brush. For the protective eyewear precaution, three subjects decided not to wear goggles because they felt that goggles simply weren't necessary. With regard to extinguishing the candle, two subjects read the precaution and decided not to extinguish the candle because it was too far away from the water sealer to be dangerous. In summary, the most frequently cited reason for not complying with a precaution was that it didn't seem necessary in order to prevent an accident or injury.

Forgetting to take precautions. Summing the number of precautions that each subject read across the 80 subjects, a total of 109 precautions were read. For those 109 precautions, there were 4 instances in which a subject reportedly forgot to comply. Three subjects forgot to extinguish the candle and one subject forgot to wear goggles.

Interestingly, all four subjects were in Condition 4 where the precautions were included in the directions for use and they were presented in the procedurally explicit

fashion. This finding is not surprising considering that 62 of the 109 precautions read were read by subjects in Condition 4.

In Condition 4, the rate of forgetting to extinguish the candle was one in three (33%), which is a relatively high rate for a "slip" type error. Unfortunately, the effect of label characteristics on the rate of forgetting, if they exist, were not discernable because of the small number of subjects who read the precaution to extinguish the candle. More specifically, no one in Conditions 1 and 2 read the precaution and, therefore, a rate of forgetting was not available. In Condition 3, only six subjects read the precaution and none of them forgot to comply. Thus, additional data are needed to better understand the factors affecting the relatively high rate of forgetting to comply with this particular precaution.

Assessment of Carry-Over Effects From Experiment #1

Because each subject used the drain opener in the first experiment prior to using the water sealer, it is necessary to determine the extent to which subject behavior in response to the water sealer labels might be affected by the exposure to the drain opener labels. This carry-over effect was assessed by analyzing the difference in reading of and compliance with water sealer precautions for subjects assigned to the four drain opener conditions. Using chi-square tests, it was found that the proportion of subjects complying with each of the four water sealer precautions did not differ significantly across the four drain opener conditions ($p > 0.10$). Likewise, the proportion of subjects reading each of the four water sealer precautions did not differ significantly across the four drain opener conditions ($p > 0.10$). In addition, using analyses of variance, the Precaution Compliance Scores and Precaution Reading Scores did not differ significantly across the four drain opener conditions ($p > 0.10$). Thus, the condition to which a subject was assigned in the first

experiment did not significantly affect the reading and compliance measures in the second experiment.

Summary of Key Results

Due to the large of amount of data and results previously presented, a list of key results was compiled in an effort to efficiently summarize the findings. The key results from the second experiment are as follows:

Effect of presentation factors on compliance with precautions.

- Including precautions in the directions for use significantly increased compliance with all precautions.

- Combining the compliance rates for the four precautions, the average rate of compliance was 13% when the precautions did not appear in the usage instructions, and 47% when they were included in the usage instructions.

- Increasing the procedural explicitness resulted in higher compliance rates for two of the four precautions and significantly increased the composite Precaution Compliance Score.

- Across the four precautions, the average rate of compliance was 19% when the precautions were presented in a procedurally nonexplicit manner, and 41% when they were procedurally explicit.

- In terms of precaution compliance, the interaction between precaution location and procedural explicitness was significant.

- The label producing the highest Precaution Compliance Score was that which included procedurally explicit precautions in the directions for use.

- Procedurally explicit precautions included in the directions for use produced dramatically higher compliance rates than the exemplar current label (65% versus 10%).

<u>Effect of presentation factors on attention to precautions</u>.

- Including precautions in the directions for use significantly increased the proportion of subjects who reported reading the four precautions.

- Combining the reading rates for the four precautions, the average proportion of subjects reading a precaution went from 9%, when the precautions did not appear in the usage instructions, to 59% when they were included in the usage instructions.

- Increasing the procedural explicitness resulted in higher reading rates for three of the four precautions and significantly increased the composite Precaution Reading Score.

- Combining the reading rates for the four precautions, the average reading rate was 22% when the precautions were presented in a procedurally nonexplicit manner, versus 46% when they were presented in a procedurally explicit manner.

- In terms of precaution reading rates, the interaction between precaution location and procedural explicitness was significant.

- The label producing the highest Precaution Reading Score was that which included procedurally explicit precautions in the directions for use.

- Procedurally explicit precautions included in the directions for use produced dramatically higher reading rates than the exemplar current label (78% versus 4%).

Relationship between reading and complying with precautions.

- Averaging across the precautions, 73% of the subjects took a precaution given that they read it, versus 9% who took a precaution given that they did not read it.

User processing of product information.

- The label condition did not affect the reading ratings (i.e., proportion of label/panel read) for any of the label panels or sections of the back panel.

- Subjects reported reading a much greater proportion of information on the back panel than on the side panel.

- Subjects reported reading a much greater proportion of the directions for use than any other section on the back of the label.

- Ninety-six percent (96%) of the subjects reported that they read none of the information on the side of the container.

- The viewing times for label panels did not differ across label conditions.

- The amount of time subjects spent viewing the back panel was greater than for the front panel by an average of 41.5 seconds and the viewing time for the back panel was greater than for the side by an average of 42 seconds.

- The average total viewing time for the side panel was 1.55 seconds.

- Fifty-four of the 70 subjects (77%) for which complete viewing time data were obtained spent no measurable time viewing the side panel.

Effect of subject characteristics.

- Subject gender did not significantly affect the composite reading or compliance scores.

- Subject age did not significantly affect the composite reading or compliance scores.

- Subject experience with water sealer products did not significantly affect the composite reading or compliance scores.

Product hazardousness.

- Precaution location significantly affected subject rating of product hazardousness -- no other label or subject attribute was reliably related to the rating of product hazardousness.

- Labels with precautions included in the directions for use resulted in significantly higher ratings of product hazardousness.

Reasons for not complying with precautions.

- The vast majority of times that subjects did not comply with an instruction they reportedly decided not to comply versus forgot to comply.

- The most frequently cited reason for not complying with a precaution was that it did not seem necessary in order to prevent an accident or injury.

Discussion

Summary of Presentation Factor Effects

Consistent with the results of the first experiment, the effect of precaution location was significant and substantial. As hypothesized, providing a complete procedure for the safe and effective use of the water sealer in a central location substantially increased the proportion of subjects who read and complied with the precautions.

In addition, increasing the procedural explicitness of the precautions increased the attention to and compliance with two of the four precautions and significantly increased the composite reading and compliance scores. Though it was a significant factor, the effect of procedural explicitness was much less pronounced than the effect of precaution location relative to usage instructions. In fact, providing procedurally explicit precautions separately from the directions for use was less effective (in terms of attention to the precautions) than providing procedurally nonexplicit precautions in the directions for use.

The more important aspect of the explicitness factor was its interactive effect with the location factor. That is, the two presentation factors interacted such that the most effective label condition was that which presented the precautions in the directions for use and in a procedurally explicit format (i.e., providing information in a location where users are likely to be processing text at a meaningful level and in a manner that minimizes the situation-specific inferences). Thus, the benefits of procedurally explicit precautions were minimal unless the precautions were included in the usage instructions. As in the first experiment, these benefits were achieved without significantly increasing the amount of time subjects spent viewing the panels of the container.

User Processing of Product Information

This experiment produced a number of insights into how people use and process product information during product use. First, the finding that subjects read only portions of certain sections of the label (e.g., precautions section) illustrates that users tend to selectively attend to certain portions of the label rather than process each and every section in its entirety. Second, subjects' information processing was typically guided by the search for instructions to perform the required task. To some extent, this is to be expected, since there was no question that the water sealer product was applicable for the task at hand and that all necessary tools and equipment were available. Nonetheless, the results illustrate that label processing was goal-directed as opposed to an exhaustive reading of the label.

Third, in addition to limited processing of nonprocedural sections of the label, several subjects exhibited text-level filtering of the precaution statements that appeared in the directions for use. More specifically, a number of subjects read just the first few words of the precaution statements (e.g., keep away from open flame or spark) and then moved on to the next step in the procedure. This truncated processing of precaution statements is consistent with the previously mentioned studies by Friedmann (1988) and Strawbridge (1986) in which a substantial proportion of subjects read only the initial portion of product warning statements and then moved on. This text-level filtering suggests that users tend to evaluate or predict the utility of subsequent text processing.

Fourth, the finding that 96% of the subjects did not read any of the information on the side panel of the container illustrates the strong tendency that subjects had for initially seeking information on the back panel of the container and for seeking information pertaining to the use of the product to perform the task at hand, as opposed to searching for other information about the product. In fact, 54 of the 70 subjects for whom complete viewing time data were obtained spent no time at all viewing the side panel. This lack of attention to the side of the container suggests that users may have had *a priori* expectations

about the general location of information they were seeking. In this case, the location of usage information was apparently consistent with their expectations. Additional research is needed to determine the effect of user expectation regarding message location on the processing of product information and, ultimately, the implications of user expectations on the design and presentation of safety-critical messages. An interesting experiment along these lines would to be place the precautions on the back panel and the instructions on the side panel to determine whether users are more likely to attend to the precautions than they were in this experiment.

Integrating Warnings Into Flow of Task Information Versus Increasing Stimulus Intensity

According to Lehto and Miller (1986) a research topic of pressing interest is the relative importance of integrating a warning message into the flow of task-related information as opposed to increasing the intensity or conspicuity of the warning. This experiment begins to shed light on this important topic. First, the results of this experiment suggest that the usage instructions were typically part of the task-related information that subjects processed in order to perform the task. Second, when the safety-critical messages were included in the usage instructions, the proportion of subjects attending to the messages increased. This increased attention was not the result of an increase in the conspicuity or salience of the precautions. On the contrary, the precautions appearing in the directions for use were not presented in bold print as they were on the side of the container. In other words, outside the context of product use, the precautions appearing on the side of the container would be considered more salient than those appearing in the directions for use. Nonetheless, this apparent decrease in salience actually increased the attention to and compliance with the precautions because subjects were generally more prone to read information within the usage instructions. Again, this illustrates the importance of integrating warning information into the flow of task information, relative to

exclusively considering the stimulus intensity of the warning in relation to other label components.

As in the first experiment, the results of this experiment suggest that a warning judged to be highly conspicuous outside the context of task performance may, in fact, be less likely to be processed than an apparently inconspicuous warning that is a subset of the task-related information users are likely to process. Once again, the implication is that the nature of the interaction between the user, product, and product information is an important consideration during the design and evaluation of product warnings and instructions.

Difficulty Conveying Flammable Vapor Hazard

Relative to the other three precautions, the precaution to extinguish the candle was difficult to convey to the subjects. Even though all of the label conditions contained the statements, "Flames or sparks, even in nearby rooms, can ignite vapors and cause flash fire," and "Vapors are harmful if inhaled and can cause flash fire if allowed to accumulate," few subjects recognized the need to extinguish the nearby candle and even fewer extinguished it. In fact, when the precautions appeared only on the side of the container no one recognized the need to extinguish the candle and no one took this precaution. And, when the precautionary information appeared in the directions for use, fewer than half of the subjects recognized the need to extinguish the candle and fewer than one third proceeded to extinguish it.

The low rate of recognition of this precaution can, in part, be attributed to the fact that numerous subjects processed only the initial words of the entire warning regarding vapor flammability. This partial processing of the flammability warning suggests that users were either not interested in knowing about the fire hazard of the product or they felt that the subsequent information would not provide them with sufficient new and/or useful information to warrant additional reading. Regardless of the reason why people stopped

processing the information, they clearly did not infer the specific precautions to be taken in this situation. This finding is consistent with research involving an extremely flammable contact adhesive in which subjects easily recognized that the product was "flammable" based on its warning symbols and accompanying text, but few recognized the flammability of the product's *vapors* and the specific precautions necessary to avoid common fire scenarios associated with product use (Frantz, Miller, and Lehto, 1991). The basic problem exposed by the present experiment and that of Frantz, Miller, and Lehto (1991) is that users can recognize that a product is flammable but not recognize the mechanism by which fires can occur (i.e., ignition of vapors by a spark or open flame several yards away from the point of product use), or recognize the situation-specific precautions that need to be taken to prevent flash fires. Furthermore, in the present experiment, adding explicit written information regarding vapor flammability did not elevate the awareness of vapor flammability to the extent initially expected. Because of the prevalence of flammable vapor fires with a variety of consumer products (cf. Nelson, 1976), additional research and development efforts are of pressing importance in order to more effectively convey the nature of the hazards and precautions associated with flammable vapors.

CHAPTER V

GENERAL DISCUSSION AND CONCLUSIONS

Implication of Results to Current/Recommended Practice

The results of these experiments suggest that the current/recommended practice of separating safety instructions from usage instructions is less effective than integrating safety and usage instructions to provide a centrally located, complete procedure for the safe and effective use of the product. The implication of these results is that the current systems for labeling hazardous products could be improved through the inclusion of precautionary instructions in the directions for use. Example labeling systems include the paint and coatings industry labeling guidelines and the labeling regulations and guidelines pertaining to pesticides.

These results also call into question Ryan's (1991) recently proposed, but empirically unfounded standard for hazardous labeling and cautionary instructions for consumer products which calls for warnings and cautionary instructions to be separate from product use instructions. This recommendation is clearly not supported by the results of either experiment. Instead, both experiments suggest that cautionary instructions should be embedded in the product use instructions.

It is important to recognize that Ryan's proposed method of labeling is directed toward helping the user "... know where to look for the warning. [Because] many consumers don't want to, or have the necessary literary skills to, read through the label to find the warning." Implicitly, his assumption is that users have a desire to seek out product

safety information from amongst the plethora of information on labels, as opposed to the premise of this research that users are primarily interested in obtaining information to use a product to perform a task. While users may initially seek out warning information for some products, this was rarely the case with either of the two products studied. To accommodate both scenarios, a reasonable strategy for conveying safety information on product labels would be to include routinely executed precautions in the usage instructions and also include the information in a separate warnings section that addresses general hazard information.

Value of a Systematic, Human Factors Approach to Warning and Instruction Design

Recall that one of the basic problems in the area of product warnings and instructions is that the human factors community has had difficulty convincing industry groups and government agencies that a systematic, human factors engineering approach is critical to the design of effective product safety information. To some extent, this situation exists because of the lack of published case studies illustrating that warnings and instructions developed through a systematic, human factors approach are likely to be more effective than those based on untested assumptions regarding user processing of information or empirically unfounded, established practice. These experiments can serve as two such case studies. In particular, this research supports the contention that designing warnings and instructions that are compatible with expected user information processing strategies can substantially improve the attention to and compliance with safety-critical information. Recent research by Frantz and Rhoades (in press) provides converging evidence that human factors methodologies can be applied to provide a measurable improvement in the effectiveness of safety-critical product information. In that research, a cognitive and behavioral task analytic approach was successfully applied to the problem of determining where to locate a warning accompanying a file cabinet. Heretofore, such

empirical evidence has either not been gathered or, if gathered, has not been made known to industry or government groups.

An additional practical point regarding the improvements in label effectiveness is that the increased attention to and compliance with the safety instructions was achieved through relatively minor changes to the labels. For example, increased effectiveness for the drain opener label was obtained by simply moving information within the same panel of the label where it originally appeared. That is, new information was not added and additional space was not required (except for a small amount for the numbered list condition) in order to produce a more effective label. It is important to note, however, that large improvements in warning effectiveness may not be obtained with a more diverse group of subjects who may be less inclined to read any information on the product. In fact, for other products and evaluation scenarios, the modifications to product warnings have needed to be more substantial in order to produce the reading and compliance rates similar to those observed in this study (cf. Frantz and Miller, 1992; Frantz and Rhoades, in press).

A final benefit associated with systematically evaluating the various label designs was that potential methods for further improvements to the labels became apparent. For example, in the first experiment, it was found that a common reason for subjects not to comply with safety instructions after reading the instruction was that subjects could not understand how their eyes and skin were at risk. They felt that as long as they were careful, the drain opener could not get on their skin or in their eyes. These responses suggest a fairly common disparity between user perceptions of accident scenarios and known accident scenarios (in this case splashbacks of lye onto users). Knowledge of this type of disparity can provide warning designers with valuable insights for improving product information.

User Processing of Product Information

This research provides initial insights into how people use and process on-product information during task performance. The results from both experiments support the notion that users tend to search for information that is directly related to using the product to perform a task, as opposed to searching for product information that is not directly related to task performance (e.g., general safety information). In both experiments, the search process involved scanning and filtering out chunks of information that did not appear to be relevant to task performance. Typically these filtered chunks of information included the precautions section of the label.

Fundamentally, this research illustrates that people who recognize a need for written product information and proceed to use it do not necessarily read the information in the same manner as other documents (e.g., books, magazines, and forms). Rather, they process information at varying degrees of depth and assess the utility of additional processing of a chunk of information. When further processing of a chunk of information is deemed to have insufficient value, the user moves on. In these experiments, the chunks of information appeared to be blocks of text separated by white space or borders, paragraphs, and even sentences (in the case of the water sealant flammability warning). Based on subject interviews, a common processing strategy was to sample information from a chunk of information and make some determination as to the utility of deeper, more time consuming processing of the information. Two common criteria which users seemed to apply in determining or predicting the value of deeper processing were: 1) the extent to which the information in a chunk of information might assist in achieving their goal (i.e., completing the task for which the product is used), and 2) the extent to which the sampled information was consistent with their *a priori* expectations of the product and their prior knowledge and experience with similar products.

There are two implications of these findings regarding user processing of product information. First, designing on-product information based on the presumption that users will be reading the information in the same manner as other documents is not a sound approach. These experiments illustrate that on-product information is more appropriately viewed as a means to an end or as a tool that is used on an as-needed basis, as opposed to other documents such as books and forms where the user's primary objective is to read to acquire knowledge (both declarative and procedural) or to be entertained.

Second, during the design of product warnings and instructions, it is important not only to decide what messages to provide to users, but also to determine how to present the information to users in such a way as to minimize user filtering of critical information. In other words, simply providing a warning or instruction does not imply that it will be processed to a meaningful degree, even by those users who seek out product information. This finding is of particular relevance to those members of the legal community whose primary objective of merely providing a warning is achieved without considering the likelihood that the warning will be processed during actual product use.

Basis for Relative Importance of Location Factor

Relative to the other presentation factors studied, integrating the safety instructions and precautions into the usage instructions produced the most dramatic increase in label effectiveness in both experiments. Based on the findings regarding how people used and processed product information, the relative importance of the location factor appears to stem from the fact that moving the safety information into the usage instructions effectively moved the information into the flow of task-related information that users were searching for and willing to process at a meaningful level. In contrast, the effect of presentation format (prose versus numbered list) and procedural explicitness of precautions did not serve the same role in terms of promoting user attention to the messages. Instead, these

two factors were directed more toward facilitating user compliance and reducing user errors associated with repeated re-entry into the procedural text.

The implication of these results is that warnings and instructions designed to be compatible with user information processing objectives and strategies can be substantially more effective than safety information that is not designed in such a manner. This research further suggests that the apparent enhancement of safety information (e.g., use of colors, increased type size, and procedural explicitness) is likely to be of limited value unless the information is within the task-related information that users are likely to process. In other words, if verbal safety instructions and warnings are not included in the task-related information that users are likely to process, then the salience of the safety information will need to be increased substantially in order to promote meaningful processing by the user. Based on these two experiments, the more reliable of the two approaches is to include the safety information in the flow of task information.

A final point regarding the relative importance of the location factor is that the difference between the presentation factor effects illustrates that different presentation factors play different roles in facilitating safe use of products. That is, some presentation factors promote attention to product information, whereas others assist users in understanding the nature of product hazards and the specific measures to be taken to avoid the hazard. The implication of this observation is that the importance of different presentation factors will vary across products and product/user combinations. For example, the procedural explicitness of precautions may be an important presentation factor for a consumer product used by lay individuals, whereas procedural explicitness may not be important for the same product used in a commercial or professional setting where the user's previous experience and knowledge can provide for greater inferencing from less explicit precautions.

Recommendations for Design of Product Warnings and Instructions

The results of this research have a number of implications and/or recommendations for the design of product warnings and instructions. The dissertation concludes with a description of these major recommendations.

Integrate safety-critical messages into the flow of task-related information. The general design recommendation that follows from this research is that safety-related procedures should be integrated into the flow of information that users are likely to process. This recommendation is consistent with Lehto's (in press) generic warnings design guideline to integrate warnings into the task and hazard related context. A more specific recommendation is that precautions that are intended to be taken on a cyclic basis should be included in the usage instructions so that a complete procedure for the safe and effective use of the product is provided in a central location. This design recommendation follows directly from the location factor effects in both experiments.

Determine expected user information processing objectives/strategies. The present research clearly illustrates the importance of designing product safety and usage information to be compatible with expected user information processing strategies and objectives. The implication of this finding is that the design of product safety information should include an analysis of the information processing objectives that users are likely to have. In other words, by determining the task-related information (verbal or otherwise) that users are likely to process, the designer can identify key spatial and temporal locations to insert safety-critical messages. Additional support for this recommendation is provided by Frantz and Rhoades (in press).

It is interesting to note that the current emphasis when designing product warnings is on the warning's attractiveness and conspicuity outside of the context of product use. The present experiments suggest that the emphasis would be more appropriately placed on integrating the warnings into the flow of task information rather than designing and

evaluating the information in isolation. Designing the safety information to be included in the flow of task-related information is a more complex task requiring skills and resources well beyond those required to develop warnings by applying industry standards or guidelines. Consistent with the conclusions of Frantz and Rhoades (in press), the present research suggests that relying solely upon warning design guidelines and standards that do not consider the user's cognitive and behavioral activities during product use cannot be expected to produce maximally effective warnings. That is, general standards such as ANSI Z535.4 and other standards for specific types of products are but one consideration in the design process. Furthermore, it is of paramount importance to consider the nature of the interaction between the product, user, and product information (cf. Frantz, Miller, Lehto, 1991; Laughery and Brelsford, 1991; Miller, Frantz, and Rhoades, 1991; Robinson, 1991; Wright, 1980).

Make precautionary text as procedurally explicit as possible. The results of the water sealer experiment illustrate that, to the extent possible, precautions should be presented in a procedurally explicit manner. This recommendation is consistent with Lehto's (in press) generic warning design guideline to make symbols and text as concrete as possible. The difficulty in adhering to this recommendation is balancing the length of concrete statements against the amount of inferencing required by shorter, abstract precautionary statements. Since the appropriate level of explicitness or concreteness is greatly dependent on the skill and knowledge of product users, it is necessary to consider the knowledge and experience of users and identify expected product usage scenarios in order to determine the proper level of procedural explicitness for safety precautions. Clearly, more research is needed into the factors that affect text-level filtering of written warnings in order to provide more concrete guidelines to product information designers.

APPENDICES

APPENDIX A

OBSERVATION AND SUBJECT RESPONSE FORM

Observation and Subject Response Form

Subject #_____

Drain Cleaner Condition____________Water Sealant Condition____________

Combination Condition #__________

Time:______________Date:________________

Weight of Drain Cleaner at: Beginning of Session:________End of Session:____________

Experimental Observations

<u>During use of drain cleaner, did subject:</u>

1. Remove **standing water** before dispensing lye? Yes No
2. Remove **drain sieve** before dispensing lye? Yes No
3. Appear to **read top of can** after attempting to remove cap? Yes No
4. Wear **goggles** while dispensing lye? Yes No
5. Wear **gloves** while dispensing lye? Yes No
6. Dispense lye with a **plastic spoon**? Yes No
   If no, what was used?
   a. metal spoon?
   b. poured lye directly from can into sink.
7. Use proper amount of drain opener (i.e., <35 grams) Yes No
8. **Replace cap** after dispensing lye? Yes No
9. Was lid of can **snapped securely in place** at end of experiment? Yes No

<u>During use of Water Sealant, did subject::</u>

10 Extinguish **candle flame** before applying sealant? Yes No

11 **Open the window** before applying sealant? Yes No

12 Make any other attempts to **ventilate work area**? Yes No
If yes, explain____

13 Wear **gloves** when applying product? Yes No

14 Wear **goggles** when applying product? Yes No

Notes:____

____

Post-Experiment Questions

I would like to ask you a few questions about the products that you used. I'd like to begin by concentrating on the drain opener.

Using this scale, please answer the following questions:

15 In your opinion, how hazardous is the drain cleaner to use?________

16 In your opinion, how hazardous is the water repellent sealer to use?______

17 Using this scale, how would you describe the amount of information that you read on the **front** of the drain cleaner container? Would you say that you read, none of it, a little of it, some of it, about half of it, most of it, almost all of it, or all of it?________

18 How much of the information on the **back** of the label did you read?

____

- Using the same scale as before, how much of the:

  19 **Precautions** section did you read?___
  20 How much of the **First Aid** section did you read?_______
  21 How much of the **Storage and Disposal** did you read?_________
  22 How much of the **Directions for Use** did you read?___________
  23 Finally, how much of the **top** of the can did you read?_________

24 *If subject read any of top of can:* Did you read the information on the top of the can before or after trying to remove the cap? Before After

25 *For those subjects who read only some of the information on the back, ask:* Apparently you selected certain portions of the back of the label to read. How did you decide what information to read and what information not to read?______________________________

____

____

26 How would you describe the way you used the information on the back of the drain opener? Did you:

a. Read a sentence or two and then perform an action;
b. Did you read the majority of the information first, then go back and read a sentence or two and perform an action; or
c. Did you refer to the label only when you were unsure of what to do;
d. or what?______________________________

____

27 Did you notice that the label instructed you to make sure the water in the drain was cool before dispensing the drain opener? Yes No

28 Did you check to see if the water in the sink was cool? Yes No

28Y *If yes,* Is that because:
a. The label instructed you to.
b. You thought it would be a good idea even though you didn't notice that the label instructed you to.
c. You touched the water before you read that part of the label and realized that it was cool.
d. Other____________________________________

28N *If no,* Is that because:
a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to. Why not?
d. Other____________________________________

29 I noticed that you used a plastic spoon to dispense the drain opener? Is that because:
a. The label instructed you to.
b. You thought it would be a good idea to even though you didn't notice that the label instructed you to.
c. You were planning on using a plastic spoon even before you noticed that label instructed you to.
d. Other____________________________________

30 I noticed that you used a metal spoon instead of a plastic one. Is that because:
a. You didn't know you were supposed to use a plastic spoon.
b. The label instructed you to use a plastic spoon but you forgot.
c. The label instructed you to use a plastic spoon but you decided not to. Why not?____________________________________
d. Other____________________________________

31 I noticed that you poured the drain opener directly from the can into the sink rather than using a spoon. It that because:
a. You didn't know you were supposed to use a plastic spoon.
b. The label instructed you to use a plastic spoon but you forgot.
c. The label instructed you to use a plastic spoon but you decided not to.
d. Other____________________________________

31A I noticed that you removed the water that was initially standing in the sink. Is that because:

a. The label instructed you to.
b. You thought it would be a good idea to even though you didn't notice that the label instructed you to.
c. You were planning on removing the water even before you noticed that label instructed you to.
d. Other____

____

31B I noticed that you didn't remove the water that was standing in the sink. Is that because:

a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to.
d. Other____

31C I noticed that you removed the drain sieve that was initially in the sink. Is that because:

a. The label instructed you to.
b. You thought it would be a good idea to even though you didn't notice that the label instructed you to.
c. You were planning on removing the drain sieve even before you noticed that label instructed you to.
d. Other____

____

31D I noticed that you didn't remove the drain sieve in the sink. Is that because:

a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to.
d. Other____

31E Do you recall reading the amount of drain opener to put in the drain?

Yes No

32 I noticed that you didn't wear goggles. Is that because:

a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to. Why not?_____

____

d. Other____

33 I noticed that you wore goggles. Is that because:
a. The label instructed you to.
b. You thought it would be a good idea to wear them even though you didn't notice that the label instructed you to.
c. You were planning on wearing them even before you noticed that label instructed you to.
d. Other____

34 I noticed that you didn't wear rubber gloves. Is that because:
a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to. Why not?_____
____
d. Other____

35 I noticed that you wore rubber gloves. Is that because:
a. The label instructed you to.
b. You thought it would be a good idea to wear them even though you didn't notice that the label instructed you to.
c. You were planning on wearing them even before you noticed that label instructed you to.
d. Other____

35A I noticed that you replaced the cap to the drain opener after you dispensed the drain opener. Is that because:
a. The label instructed you to.
b. You thought it would be a good idea to even though you didn't notice that the label instructed you to.
c. You were planning on replacing it even before you noticed that label instructed you to.
d. Other____

35B I noticed that you didn't replace the cap to the drain opener after you dispensed the drain opener. Is that because:
a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to.
d. Other____

36 According to the label, is this product suitable for use in unclogging a toilet? Correct Incorrect Don't Know

37 According to the label, what should you do if are getting ready to use the drain opener and you discover that it has hardened in the can?________________________________
____Correct Incorrect Don't Know

38 According to the label, when using the drain opener, when is an appropriate time to use a plunger?____
____Correct Incorrect Don't Know

Now, I'd like to ask you some questions about the water sealant product.

39 Using the same scale as before, how would you describe the amount of information that you read on the **side** of the container?__________

40 How would you describe the amount of information that you read on the **front** of the container? ____________________

41 How would you describe the amount of information that you read on the **back** of the container? ____________________

Using the same scale as before, how much of the section entitled:

42 "What is Taylor's Water Repellent Sealer" did you read? __________
43 How about the section entitled "Taylor's Benefits"?_____
44 Finally, how much of the section entitled "Directions for Use" did you read?_______

45 *For subjects in Conditions 3 and 4,* Did you notice that some of the information on the side of the container also appeared on the back of the container? Yes No

46 If yes, What messages appeared on both the side and the back?____

____

47 I noticed that you didn't open the window before using the water sealant. Is that because:

a. You didn't know you were supposed to.
b. The label instructed you to but you forgot.
c. The label instructed you to but you decided not to. Why not?_____
____
d. Other____
____

48 I noticed that you opened the window when using the water sealant. Is that because:

a. The label instructed you to do so.
b. You thought it would be a good idea even though you didn't notice that the label instructed you to.
c. You were planning on opening the window before you noticed that label instructed you to.
d. Other____
____

49 I noticed that you didn't wear goggles. Is that because:
  a. You didn't know you were supposed to.
  b. The label instructed you to but you forgot.
  c. The label instructed you to but you decided not to. Why not?_____
  ____
  d. Other____
  ____

50 I noticed that you wore goggles. Is that because:
  a. The label instructed you to.
  b. You thought it would be a good idea to wear them even though you didn't notice that the label instructed you to.
  c. You were planning on wearing them before you noticed that label instructed you to.
  d. Other____
  ____

51 I noticed that you didn't wear rubber gloves. Is that because:
  a. You didn't know you were supposed to.
  b. The label instructed you to but you forgot.
  c. The label instructed you to but you decided not to. Why not?_____
  ____
  d. Other____

52 I noticed that you wore rubber gloves. Is that because:
  a. The label instructed you to.
  b. You thought it would be a good idea to wear them even though you didn't notice that the label instructed you to.
  c. You were planning on wearing them before you noticed that label instructed you to.
  d. Other____

53 I noticed that you didn't blow out the candle. Is that because:
  a. You didn't know you were supposed to.
  b. The label instructed you to but you forgot.
  c. The label instructed you to but you decided not to. Why not?_____
  ____
  d. Other____

54 I noticed that you blew out the candle. Is that because:
  a. The label instructed you to.
  b. You thought it would be a good idea even though you didn't notice that the label instructed you to.
  c. You were planning on blowing out the candle them before you noticed that label instructed you to.
  d. Other____

55 During the experiment, did you know that this was a fictitious brand of drain opener?
Yes No

56 During the experiment, did you know that this was a fictitious brand of water sealant?
Yes No

57 How many times have you used a water sealant product before today?
Never, Once, a Few times, or Many times.

58 When was the last time you used a water sealant product?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

59 How many times have you purchased a water sealant product?
Never, Once, a Few times, or Many times.

60 When was the last time you purchased a water sealant product?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

61 How many times have you used a **crystal** drain opener before today?
Never, Once, a Few times, or Many times.

62 When was the last time you used a **crystal** drain opener?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

63 How many times have you purchased a **crystal** drain opener?
Never, Once, a Few times, or Many times.

64 When was the last time you purchased a **crystal** drain opener?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

65 How many times have you used a **liquid** drain opener before today?
Never, Once, a Few times, or Many times.

66 When was the last time you used a **liquid** drain opener?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

67 How many times have you purchased a **liquid** drain opener?
Never, Once, a Few times, or Many times.

68 When was the last time you purchased a **liquid** drain opener?
Within the last few **Days**, Within the last few **Weeks**, Within the last few **Months**, Within the last few **Years**, **Never**

69 If you had been using the drain opener in your own home, would you have read **more** of the information on the container, **less** of the information, or about the **same** amount? If more or less, why?________________________________

70 If you had been using the water sealant product in your own home, would you have read **more** of the information on the container, **less** of the information, or about the **same** amount? If more or less, why?________________________________

____

71 Class: Freshman Sophomore Junior Senior Graduate Student

72 Do you wear contact lenses? Yes No

73 Wearing glasses? Yes No

74 Age______________

75 Gender: Male Female

APPENDIX B

CONSENT FOR EXPERIMENTAL PROCEDURE

Consent for Experimental Procedure

Research Project
"The Effect of Background Music on the Performance of Household Tasks"

Primary Researcher
J. Paul Frantz, Ph.D. Candidate

Description of Research
The experimental procedure involves performing several household tasks under a particular type of background music. The tasks to be performed will involve the use of consumer products of the type that are available to and used by ordinary consumers. The tasks do not involve any special skills, climbing, lifting or moving heavy objects, or the use of electrical equipment. The entire session lasts approximately 45 minutes.

Management of Physical Injury
In the event of physical injury resulting from research procedures, the University will provide first-aid medical treatment. Additional medical treatment will be provided in accordance with the determination by the University of its responsibility to provide such treatment. However, the University does not provide compensation to a person who is injured while participating as a subject in research.

Subject Payment
You will receive $10 for participating in the study.

Confidentiality of Information Collected
You will not be identified in any reports on this study. The records will be kept confidential to the extent provided by federal, state, and local law.

Availability of Further Information
For further information about the research, your rights, or any injury you may feel is related to this study, contact either of the following:

Graduate Student Researcher	Faculty Advisor
J. Paul Frantz	Dr. James M. Miller
2232 Fuller Rd. Apt. 201	2392 Fuller Rd.
Ann Arbor, MI 48105	Ann Arbor, MI 48105
665-7420	763-2189 or 665-1293

Voluntary Nature of Participation
Your participation in this project is voluntary. Subsequent to your consent, you may refuse to participate in or withdraw from the study at any time without penalty or loss of benefits to which you may otherwise be entitled.

I have read the information given above. I understand the meaning of this information. I hereby consent to participate in the study.

Name:________________________________

Signature:________________________________

Date:______________________Time:______________________

This form follows the guidelines of the LS&A Human Subjects Review Committee Approval Form for Studies Involving Human Subjects.

APPENDIX C

VIDEO CONSENT FORM

PRODUCT WARNINGS AND INSTRUCTIONS STUDY

Video Consent Form

I, ____, have been informed that my actions during the experimental session were videotaped. I understand that it is my decision how the videotape is to be used: it can be erased, its viewing can be restricted to members of the research team for data collection only, or it can be left available for possible playing for discussion of this research among other scientists or professionals. My decision is indicated below (check):

____________ I want the tape erased.

____________ I give my permission for the members of the research team to use the videotape for data collection, but not for playing during discussion of this work with other scientists or professionals.

____________ I give my permission for the tape to be used by members of the research team not only for data collection, but also for playing in discussion of this work with other scientists or professionals, if they so desire

Signed,____

DATE:________________________.

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